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THE MARINE ENVIRONMENT OFFSHORE
FROM POINT LOMA, SAN
DIEGO COUNTY

By

CHARLES H. TURNER, EARL E. EBERT and ROBERT R. GIVEN
Marine Resources Operations



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ABSTRACT

This is the third in a continuing series of marine environment surveys conducted by the California Department of Fish and Game in cooperation with the State's Regional Water Quality Control Boards.

During February and March, 1965, Department scuba diving biologists made an ecological investigation off the western shore of Point Loma, San Diego County (into water depths of 100 feet). Data from this study, conducted for the San Diego Regional Water Quality Control Board (#9), are to be used in evaluating the effects of a submarine outfall discharge on the marine life in the area.

Twenty diving and four intertidal stations were occupied along four transects run perpendicular to shore. A modified transect-quadrat method of survey was employed to sample the biota both quantitatively and qualitatively. In addition, three orange-peel grab samples were taken near the outfall terminus (220-foot depth) primarily to determine sludge build-up.

The animal and plant assemblages were both lush and varied. The recorded species, numbers and diversities appeared typical for this general area, water depth, and bottom type. Bathymetrically, the greatest species diversity occurred in the 60- to 80-foot depths—the least in the 20. Geographically, species diversity was greatest in the central portions of the study area, and the least diverse in the northern. This correlated with the height of the bottom relief.

Although it is difficult to make comparisons with prior studies, because of different sampling techniques, the area's general biotic assemblages appeared similar, and except for the occurrence of *Capitella capitata* (a "pollution-tolerant" polychaete worm) at the outfall terminus, no adverse changes, directly attributable to outfall operations, were apparent in 1965. Five plants and 14 animals are deemed particularly hardy; these index species should be closely monitored in future studies to detect changes in their abundance relative to associated species.

Similar ecological studies should be carried out at least annually to record biotic changes which may be relative to the outfall's operation.

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The senior author is still with the DJ F22R studies; however, Ebert is now in charge of the Department's abalone investigations and Given is Resident Biologist at the University of Southern California's Santa Catalina Island Laboratory.

Charles H. Turner
Earl E. Ebert
Robert R. Given
December, 1967

INTRODUCTION¹

The California Department of Fish and Game and the State Water Quality Control Board (through Regional Board #9—San Diego) entered into an agreement 1 July 1964, whereby Department biologist-divers made an ecological investigation of the marine environment from the intertidal zone to the 100-foot depth of the Pacific Ocean off the western shore of Point Loma. The investigation included, but was not limited to: (i) a general reconnaissance off the western shore of Point Loma, and (ii) an intensive examination in the southerly portion of the study area. The investigation was directed toward an ecological assessment, by direct observation where possible, of the numbers and diversity of animal life and associated vegetation in the area. Physical data (water temperature and clarity) were recorded each day field work was conducted.

We anticipate that these data gathered will be used by the Board to describe and evaluate environmental changes (if any) which have occurred due to the operation of an ocean outfall in this area.

This study is the third in a continuing series of marine environment surveys the Department is conducting in cooperation with the State's Regional Water Quality Control Boards. Because both the diving techniques employed and the results obtained have wider application than afforded through the limited distribution of an interdepartmental report, we consider formal publication proper and necessary.

AREA DESCRIPTION

Point Loma, a hilly peninsula extending south from Mission Bay, separates and protects San Diego Bay from prevailing ocean currents. Its western shoreline features high sea-eroded cliffs.

Our study area was the narrow to moderate intertidal zone at the seacliff base, and the broad (2,000- to 3,200-yard wide), gently sloping, pavement-like mudstone-sandstone submerged terrace paralleling the Point's western shore.

In the nearshore, some sand inundation of this sea terrace is observed and occasional "pocket" beaches adjoin the exposed cliffs. Seaward into the 80-foot depths the broad pavement-like terrace is incised by shallow surge channels and covered in parts by cobbles and boulders.

The terrace edge, the remnant of a now submerged seacliff, lies in the 100-foot depths. Here the bottom relief increases and pinnacles and large boulders tower above the fine gray bottom sands. Beyond this depth, the limit of our diving survey, these fine gray sands persist into the deeper portions of the San Diego basin.

Wave action and shifting sand limited the inshore biota. In 60- to 80-foot depths, species diversity increased and prolific and complex biotic assemblages were encountered. Sand intrusion at the terrace

¹ This work was performed as part of Dingell-Johnson Project California F-22-R, "Environmental and Behavioral Studies of Coastal Sport Fishes," supported by Federal Aid to Fish Restoration funds.

edge limited invertebrate and plant speciation, but the fish fauna remained relatively high. Seaward, typical sand-bottom communities occurred.

METHODS

Field work was conducted during February and March, 1965. On the first day, a general reconnaissance was conducted from the beach and future transect locations determined. To retain continuity among studies in this area, our transects were laid out so they reached shore in close proximity to stations occupied in prior studies (San Diego Marine Consultants 1959 and 1962). During subsequent field days, four transects were run perpendicular to the shore (approximately 255° magnetic) into 100-foot depths (Figure 1):

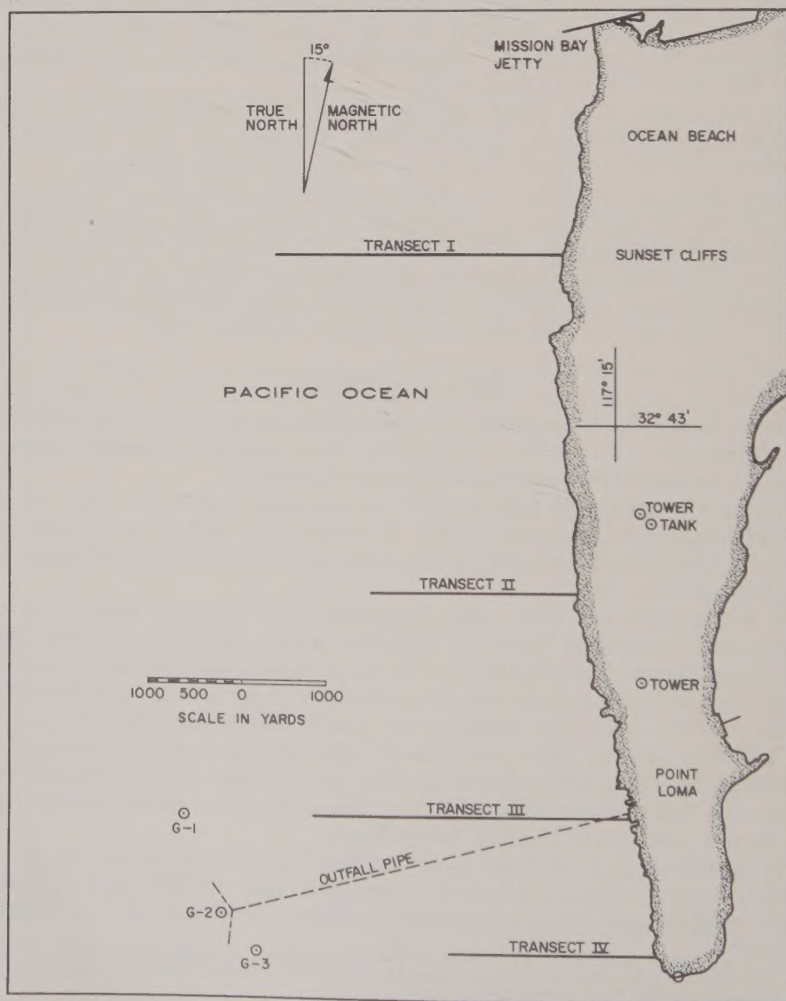


FIGURE 1 Location chart, transects surveyed and offshore collection sites, Point Loma, San Diego County.

Transect I began at the base of a promontory seaward of a large, pink, two-story building in Ocean Beach, approximately 6,600 yards north of the outfall line. It extended some 3,205 yards across the rocky intertidal and subtidal, terminating near the edge of the submerged rock terrace (100-foot depth).

Transect II began at the cliff base beneath the Naval Electronics Laboratory's sea-water pumping station, approximately 3,000 yards north of the outfall line. After traversing the rocky intertidal, the nearshore sand-smothered rock and the offshore rock terrace, it terminated on sand (100-foot depth) 2,200 yards offshore.

Transect III began at the base of the outfall pumping station, traversed the rocky intertidal, the nearshore sand and the offshore rock terrace, and terminated at the terrace's seaward edge (100-foot depth), approximately 2,800 yards offshore.

Transect IV began below the bluffs between the Coast Guard Light-house Shore Station and the concrete foundation remains of the recently removed desalination plant, approximately 1,600 yards south of the outfall line. Extending seaward across the rocky intertidal, the nearshore sand-smothered rocks, and the rocky terrace, it terminated at the 100-foot depths in rock rubble just seaward of the uplifted edge of the submerged rocky terrace, approximately 1,860 yards offshore.

Offshore operations were conducted from the Department's 20-foot cabin cruiser *Dolphin* equipped with a Raytheon DE-705A recording fathometer. Fathograms were made along each transect and then re-constructed diagrammatically for inclusion in this report (Figure 2). Diving observations were made at 20-foot depth increments along these transects (Figure 2) commencing in the 100-foot depths and proceeding shoreward. Using scuba, we occupied 20 stations along these four transects. A marker flag anchored at each station enabled us to plot its position accurately with transit sightings from shore.

To make these diving survey results quantitatively meaningful and ecologically acceptable, we modified conventional principles of terrestrial quadrat-transect sampling for use underwater.

Our actual sampling site was the spot where our anchor "set" in the bottom. We then defined each study area by attaching a measured line to the anchor and traversing a circle with this line as its radius. Quantitative observations were made within the perimeter, while outside its boundaries only more-obvious bottom topography or biological features were noted.

The bottom area covered was not the same for each station, since the effectiveness of these techniques depends upon water clarity and the complexity of the biota. The poorer the visibility the more restricted the amount of bottom that can be surveyed using these techniques, and the more diverse the biota the smaller the area the divers can critically examine. Typically, on sand stations having a limited macro-biota, we use a 3.1-meter line (about 10 feet), inscribing a 30-square-meter area (about 320 square feet). In rocky bottom areas, where the biota is more diverse, we employ a 2.2-meter line (about 7 feet) which encompasses

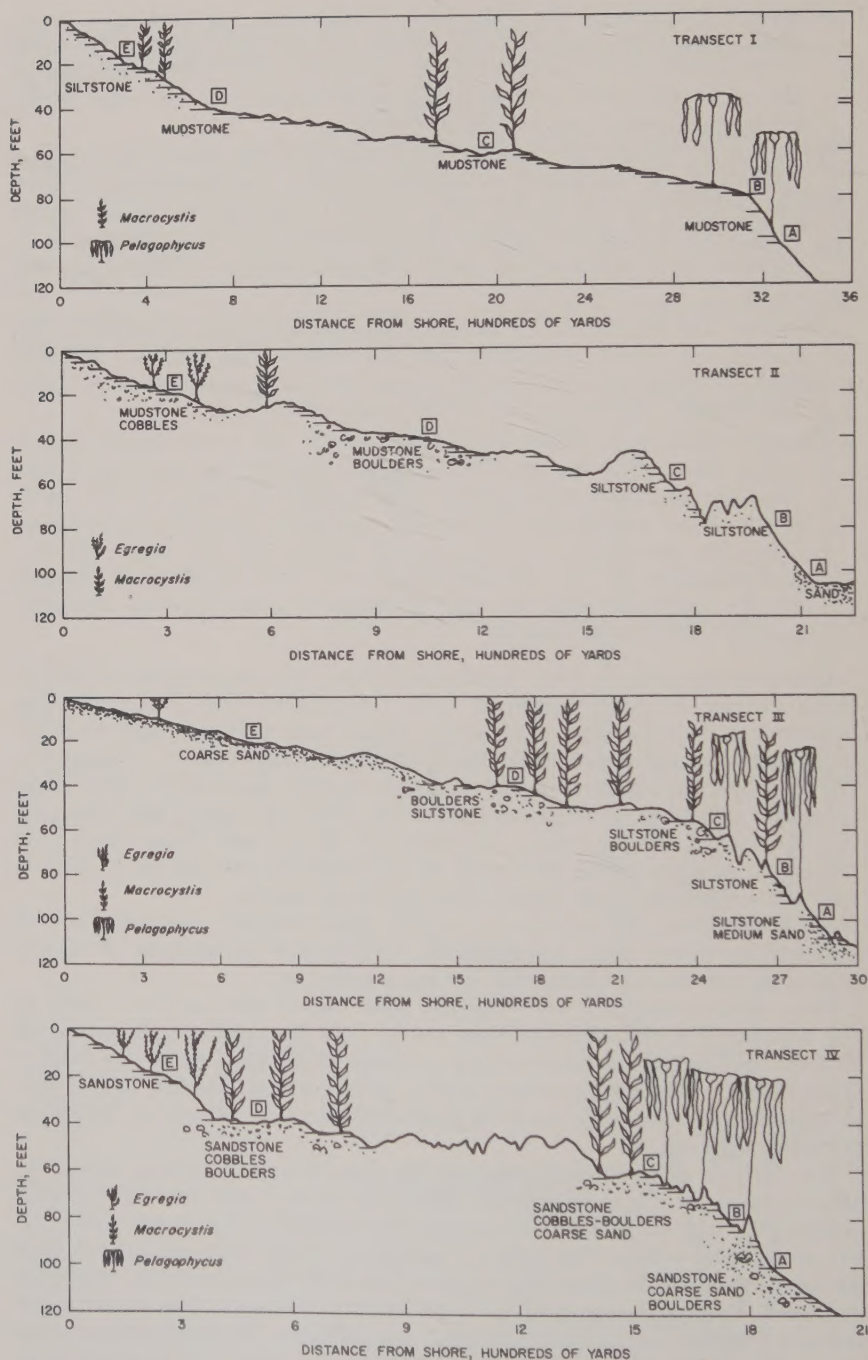


FIGURE 2 Bottom contours offshore from Point Loma, San Diego County, as interpreted from fathograms. The letter within the square indicates the sampling station.

15-square-meters (about 160 square feet). At three stations (I-E, III-D, and III-E) where the water visibility approached zero, or heavy surge hampered our work, we were unable to employ this arc method to define the study area.

Sampling conducted and data obtained at each of the diving stations included (with modifications as the situations dictated): (i) a vertical plankton tow, using a standard 18 cm diameter oblong plankton net with 62-micron mesh; (ii) obtaining a core sample; (iii) taking a substrate sample for polychaetes and Foraminifera; (iv) recording the water depth; (v) recording the water temperature; (vi) estimating the water clarity; (vii) a general description of the bottom area; (viii) enumeration by estimate of the larger plants and animals (including fish); (ix) quantitative enumeration of the larger plants and animals in the arc study area; (x) quantitative sampling (by actual removal) of growths within a quadrat 0.25 m^2 ; and (xi) making photographic records of general bottom conditions and of each quadrat prior to sample removal.

At each station, we determined the general conditions of the ocean floor (sediment composition and structure), carefully noting the presence or absence of ripple marks in sand-bottom areas.

In sand-bottom areas, we utilized a diver-held plastic coring tube to obtain a vertical profile of the sediments. This sample location is designated "C" on each station sheet. Cores were measured, the general uniformity and consistency of the sediments recorded, and the presence of putrefaction below the sediment surface (evidenced by the odor of hydrogen sulfide) noted (Appendix 1).

Water depth was measured at the anchor, using a standard (oil-filled) diver's depth gauge, calibrated in 5-foot increments, accurate to 3 feet. These were not interpolated to mean lower low water (MLLW).

We obtained water temperatures with both a diver-held thermometer and a continuously recording thermograph. Temperatures were recorded during each dive in $^{\circ}\text{C}$ at the surface, at the bottom, and at 10-foot increments above the bottom using the diver-held thermometer. We placed the thermograph on the bottom at two of the deeper diving stations (III-A and IV-B) to record diurnal-nocturnal variations.

We estimated water clarity (the horizontal distance objects were visible) throughout the water column at 10-foot depth increments to describe the general conditions under which our more-detailed biological observations were made. During previous studies (Turner, Ebert, and Given, 1964, 1965, MS) we have determined that these estimates are approximately one-half the distance recorded when a horizontal reading is made with a Secchi disc. These horizontal readings describe the transparency of the water masses within the entire water column better than the usual vertical Secchi disc readings taken from the surface.

Substrate samples were collected within each station area to determine diversity and abundance of polychaetes and Foraminifera. Polychaete samples, designated "P" on the station diagrams, consisted of approximately 1 pint of sediments skimmed from the top 1 to 2 inches of bottom. These were collected in wide-mouth quart jars, preserved in 10% formalin, and the polychaetes sent to Donald J. Reish,

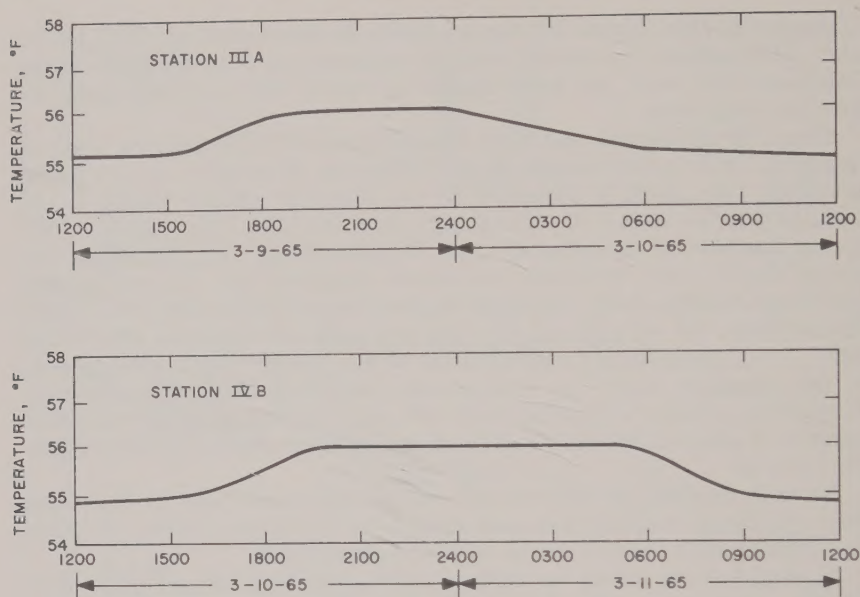


FIGURE 3 Twenty-four-hour thermograph records taken offshore from Point Loma, San Diego County, March 9, 10 and 11, 1965 (Stations III-A and IV-B).

California State College at Long Beach, for examination. We identified the other organisms collected in these samples.

Foraminifera samples, designated "F" on station diagrams, consisting of about 2 ounces of sediment were collected in 1-pint wide-mouth jars and preserved immediately in a solution of rose bengal. They have been sent to a specialist for identification, which is still pending.

Observations were recorded underwater on plastic slates and later transcribed into laboratory logs, from which this report was written. Each plastic slate had a "study area" circle inscribed upon it to enable the divers to record accurately the position of the macroscopic animals and plants at each station. We use the term "macroscopic" to define plants and animals which were visible to the divers and the term "microscopic" for organisms living in and on the substrate too small to be seen readily with the unaided eye.

All samples were tentatively sorted and preserved during the field operations with complete analysis being done in the laboratory. During the laboratory sorting, we washed all samples through a 0.5-mm-mesh screen. Organisms passing through this screen were not retained.

We also employed a transect-quadrat method of survey at four intertidal stations occupied during low tides on February 15 and 17, 1965. Here we laid out the transect line directly across the intertidal zone, from extreme low water to the upper tidal reaches. The plants and animals along this line were enumerated (by estimate) at each 10-foot increment, and at the midpoint of the line a quantitative

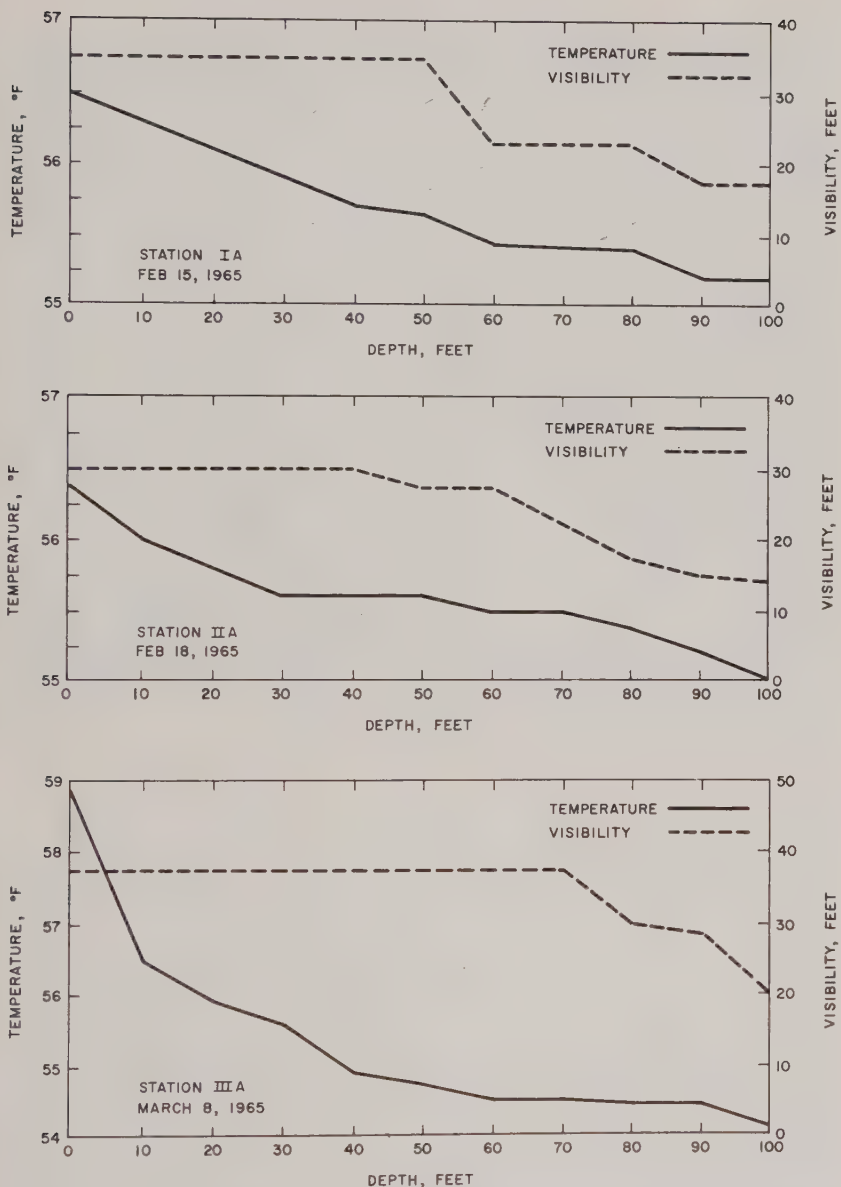


FIGURE 4 Temperature-visibility curves as functions of depth offshore from Point Loma, San Diego County, February and March 1965.

sample (by actual removal from within a quadrat 0.25 m on a side) was taken for detailed analysis at the laboratory.

Three extralimital samples were collected with a small Hayward orangepeel grab, along the 220-foot depth contour near the outfall terminus, to note any sludge build up; these data are included.

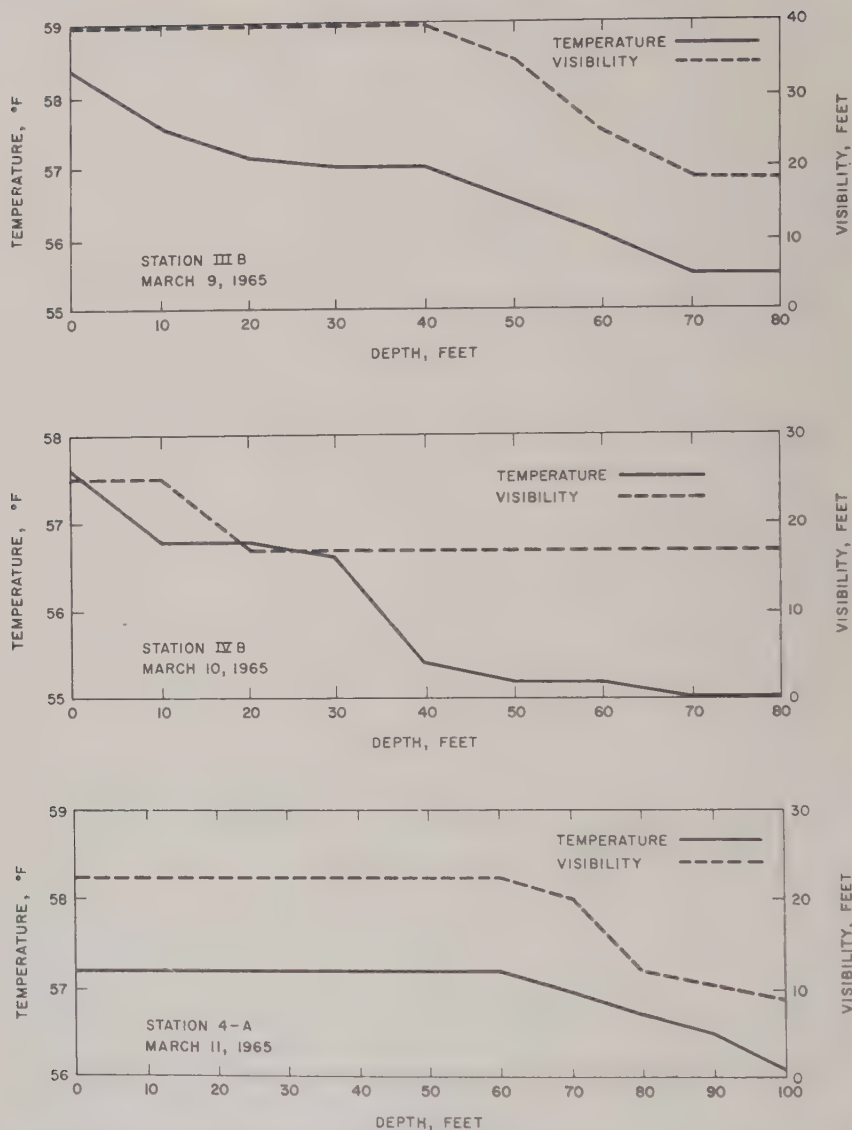


FIGURE 5 Temperature-visibility curves as functions of depth, offshore from Point Loma, San Diego County, March 1965.

FINDINGS

Transect I

The most northerly of our transects, Transect I (Figure 2), was characterized by pavement-like siltstone and mudstone. Its major relief resulted from erosion-formed channels and ledges rather than boulders and rocky outcroppings. Most of these erosion channels were filled with sand or sand and shelly debris, severely limiting the habitats available to the biota.

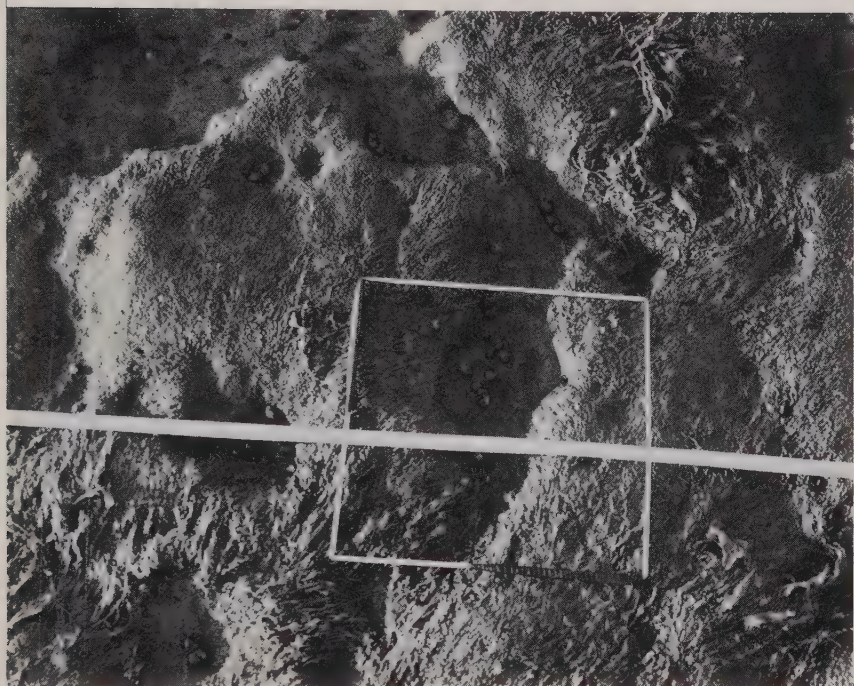


FIGURE 6 The intertidal quadrat; Transect I. Note the concentrations of littorine snails. Photo by Robert R. Given.

This line, beginning at the base of a sloping sea-cliff promontory, bordered by pocket beaches, crossed the moderate (90-foot wide) intertidal, with its deeply incised shelves, and extended across the submerged and gently sloping offshore shelf into the 100-foot depths, approximately 3,300 yards offshore.

The relatively high, sharp profile of the intertidal shelves made them a harsh environment for animal life, and speciation was severely limited: only two algae and six animals were recorded (Table 1). Most of these were on the sides of the shelf incisions rather than the shelf top. An exception was the green sea moss (*Enteromorpha* sp.) which grew abundantly throughout the spray zone (higher tide zone) environment. Littorine snails (*Littorina planaxis*) and green sea moss characterized the quadrat sample (Figure 6).

Seaward, the shelves were frequently covered by sand. This sanding-over diminished somewhat at the 20-foot depths where heavily-bored and "rotted" mudstone shelves dominated (Station I-E).

Due to severe surge and restricted visibility (about 6 inches), we know this area only by "feel" and limited collecting. Surf grass (*Phyllospadix torreyi*), 5 algae, and 37 animals were recorded (Table 1).

The first surface canopy of giant kelp (*Macrocystis pyrifera*) was encountered just seaward of Station I-E in depths of approximately

22 feet (300 yards offshore). This sparse bed was less than 200 yards wide and the plants did not appear particularly healthy. No giant kelp was recorded in the 40-foot depths (Station I-D) where we recorded, despite the restricted visibility (2 feet), 11 other algae and 32 animals (including 2 fishes) (Table 1). Low growing coralline and other red algae dominated the arc study area (Figure 7). The bottom was composed of low, heavily-bored shelves, deeply incised with surge channels filled with shelly debris and some sand. This relatively flat, gently-sloping, pavement-like bottom continued into the 60- and 80-foot depths with only a scattering of low ledges forming relief of any substantial height.

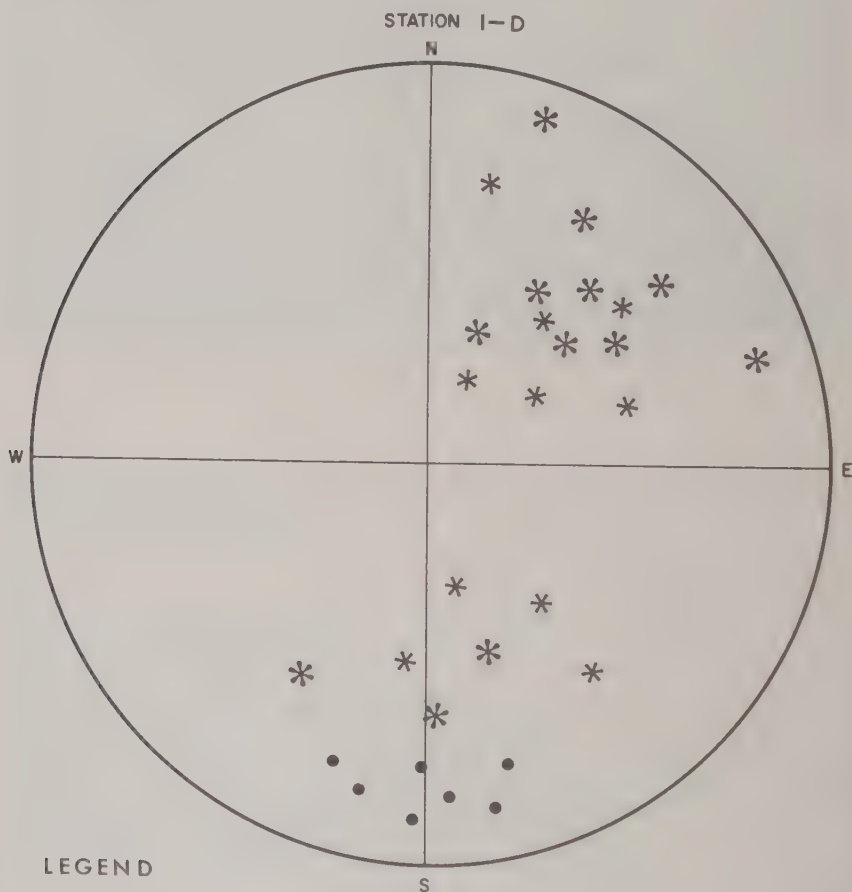
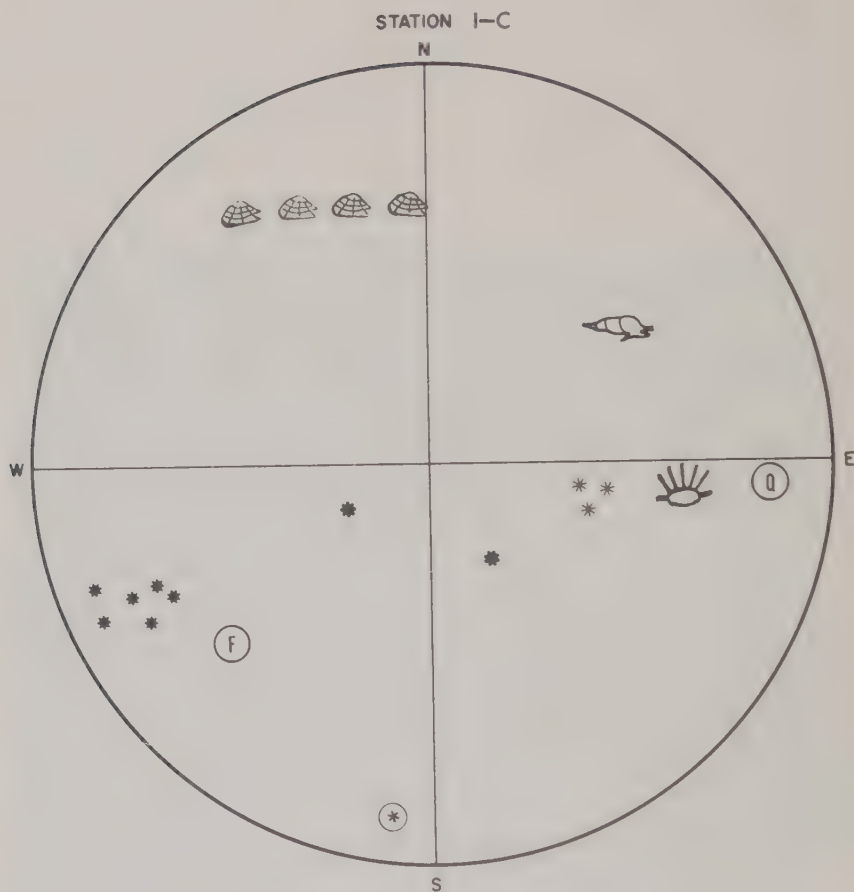


FIGURE 7 A pictorial representation of the arc study area, Station I-D (approximately 15 square meters of bottom area), 40-foot depth, depicting the more obvious biotic features.

An extensive surface canopy of giant kelp was encountered in a band approximately 1,600 to 2,100 yards from shore (waters 55 to 65 feet deep). Station I-C (60-foot depth) was in the central portion of this bed. Here the bottom was rocky, interspaced with low ledges. Eight algae and 80 animals (including 5 fishes) were recorded (Table 1). The numerous sea urchins were probably responsible for the lack of large algae in the immediate station area. Purple sea urchins (*Strongylocentrotus purpuratus*) were observed under the movable boulders (Figure 8) or far back in the crevices, while red sea urchins



FIGURE 8 Purple sea urchin concentrations on the underside of a boulder. Station I-C (60-foot depth). Photo by Charles H. Turner.



LEGEND



Keliella kelleli



foram sample



quadrat sample



Strongylocentrotus spp.



Corynactis californica



Astrangia lajollaensis



Paracyathus stearnsi



Terebratalia transversa



Parastichopus parvimensis

FIGURE 9 A pictorial representation of the arc study area, Station I-C (approximately 15 square meters of bottom area), 60-foot depth, depicting the more obvious biotic features and the sampling locations.

(*S. franciscanus*) were observed in more open areas, at the mouths of crevices or overhangs and in the rock fissures. Stony corals (*Paracyathus stearnsi*, *Astrangia lajollaensis*) and aggregate anemones (*Corynactis californica*) were dominant in the arc study area (Figure 9).

The bottom relief was slightly more prominent at the 80-foot depths (Station I-B) despite the fact that sand and debris filled many of

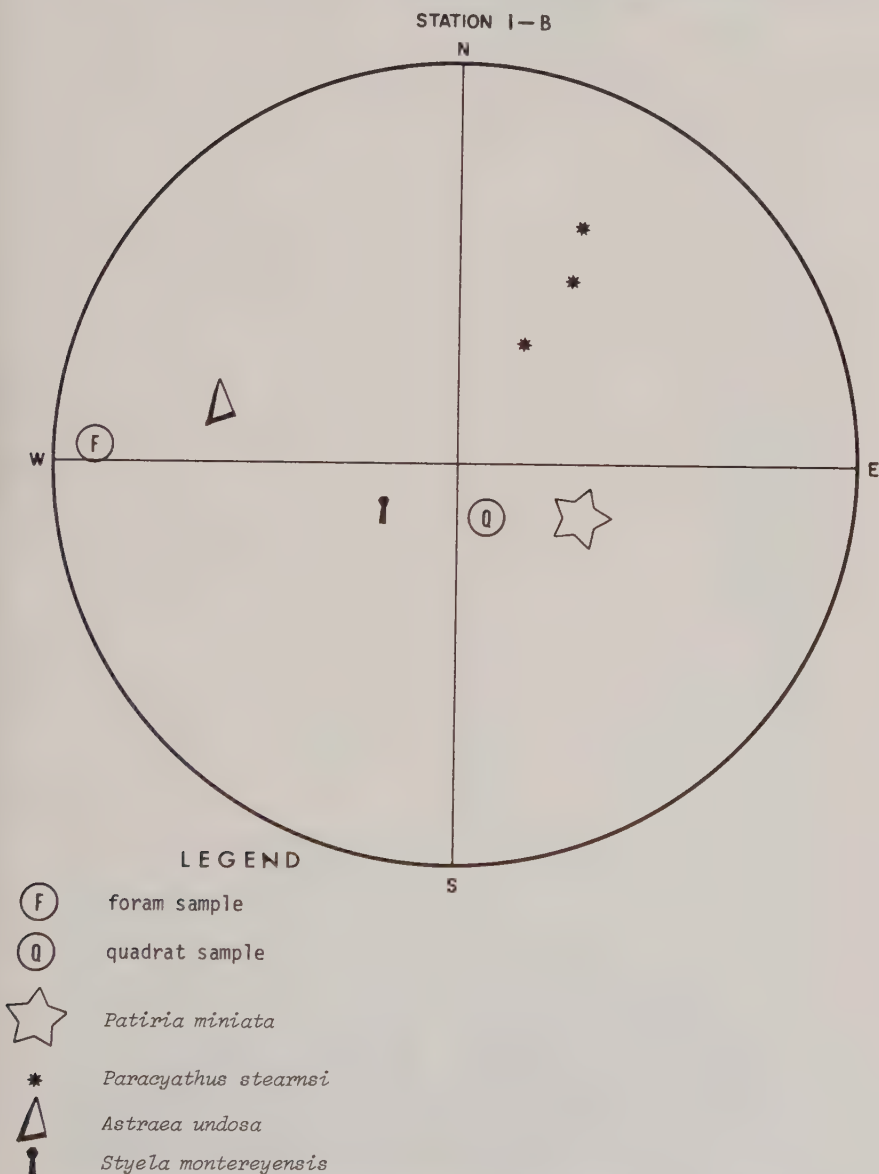


FIGURE 10 A pictorial representation of the arc study area, Station I-B (approximately 15 square meters of bottom area), 80-foot depth, depicting the more obvious biotic features and the sampling locations.

TABLE 1
Plants and Animals Recorded from Transect I, Point Loma, February 15 and 17, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
ALGAE							
<i>Codium setchellii</i>		(1)					
<i>Enteromorpha</i> sp.....		C			P		Sparse at low tide zone; abundant at high tidal zone
<i>Cystoseira osmundacea</i>			S				To 10 inches high at station E; to 3 feet high at station B
<i>Diclyota flabellata</i>				P			Small plants to 6 feet high
<i>Laminaria farlowii</i>	1/4m ² , (1)	S					One large plant seen
<i>Macrocystia pyrifera</i>	1/2m ²	1/3m ²					Healthy, to 10 feet tall at station A; grazed at station B
<i>Pelagophycus porra</i>							To 16 inches high
<i>Pterygophora californica</i>					P		
<i>Anisodactella pacifica</i>				P			
<i>Bossella orbigniana</i>		P	C		C		A small epiphyte
<i>Chondria californica</i>							
<i>Coralina gracilis</i>					P		
<i>Coralina officinalis</i>					P		
<i>Gelidium nudifrons</i>	P, (P), [1]	C	P		P		
<i>Gelidium purpurascens</i>					C		
<i>Gigartina</i> sp.....							
<i>Leptorhodia binghamiae</i>							
<i>Placomium pacificum</i>		P					Dominant alga
<i>Prionitis cornea</i>	C						
<i>Pterosiphonia dendroidea</i>			C	A			To 6 inches high at station D
<i>Rhodomenia arborescens</i>			P				
<i>Rhodomenia pacifica</i>			P				A small epiphyte
<i>Rhodomenia</i> sp.....			P				
coralline unid.....	S, (P), [4]	C, [2]	I				
Rhodophyta unid.....				(C)		C	Common at low tidal zone
<i>Phyllospadix torreyi</i>				(C)	P		A flowering plant

[C]	(P)	[12] [1]	S	[3]	
Gammaridea					
Caprellidea					
<i>Pandatus gurneyi</i>	C		3	P	Seen under rocks
<i>Pelia tumida</i>				I	
<i>Pugetia dalli</i>				P	
<i>Pugetia</i> sp.		[1]		S	Juvenile specimen
Pycnogonida					
Mollusca					
<i>Cyanoplax</i> sp.					
<i>Aegires alborpunctatus</i>					
<i>Alvania acutilirata</i>		[1]		P	
<i>Amphissa versicolor</i>		[3]			
<i>Anisodoris nobilis</i>	P	C, [1]		P	
<i>Astraea gibberosa</i>	P	C			
<i>Astraea undosa</i>	(1)	C			
<i>Cadlina flavomaculata</i>					
<i>Cadlina limbaughi</i>					
<i>Calliostoma annulatum</i>	P				
<i>Calliostoma supragranosum</i>		[1]			
<i>Calliostoma tricolor</i>		[1]			
<i>Cerithiopsis carpenteri</i>		[1]			
<i>Crepidula onyx</i>		1, [1]			
<i>Crepidula linguata</i>		I	2	P	
<i>Dendronotus frondosus</i>					
<i>Diaulula sandiegensis</i>	2				
<i>Epitonium</i> sp.	P				
<i>Erato columbella</i>		[1]		P	
<i>Fiabellina iodinea</i>	[1]	(1)			
<i>Glossodoris porterae</i>	P				
<i>Haliotis rufescens</i>	S, [1]				
<i>Hermisenda crassicornis</i>	5				
<i>Jalón festinus</i>		[1]			
<i>Kelletia kelletii</i>	I	(1)			
<i>Lacuna unilasciata</i>	P	5	15/16m ² P	P	One large adult at station A and B
<i>Littorina planaxis</i>					
<i>Littorina scutulata</i>					
<i>Megathura crenulata</i>					
<i>Micranellum crebricinctum</i>					
<i>Mitra idae</i>		[2]	1	S to A, [16]	Sparse at low tidal zone: abundant at high tidal zone
<i>Mitrella carinata</i>				S to A	Sparse at low tidal zone: abundant at high tidal zone
<i>Mitrella gouldii</i>		C	2		
<i>Retusa harpa</i>		[3]			
<i>Scilla montereyensis</i>					

TABLE 1—Continued
Plants and Animals Recorded from Transect I, Point Loma, February 15 and 17, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
<i>Serpulorbis squamigerus</i>	[1]	[P]	[1]	2	P		To 5 inches long at station A
<i>Tegula regina</i>					P		
<i>Tricokia compla</i>		S	[16]		C		
<i>Turbonilla kelseyi</i>			[1]				
<i>Zonaria spadicea</i>			[1]				
<i>Erilia californica</i>			[1]				
<i>Hiatella arctica</i>			S				
<i>Hinnites multirugosus</i>	C	P	[2]				
<i>Leptopecten latiaurula</i>	[1]		[1]				
<i>Lima hemphilli</i>							
<i>Mytilus californianus</i>							
<i>Parapholas californica</i>							
<i>Penitella penita</i>					P	P	Restricted to low tidal zone
<i>Pododesmus cepio</i>			C, (P)	1	P		
<i>Protothaca staminea</i>			[7]				Small juveniles
<i>Ectoprocta</i>							
<i>Cellaria mandibulata</i>					1		A small colony
<i>Costazia robertsoniae</i>		(P)	C, (S)		P		Encrusting on <i>Bostella</i> at station B
<i>Crista mazima</i>	[S]		[1]				A small colony at station C
<i>Crista occidentalis</i>			1		S		A small colony
<i>Crista</i> sp.....		C, (C)	(S)				Low colonies; some growing on stony corals
<i>Cryptosula pollasiana</i>			P				Small colonies
<i>Diaperoeca californica</i>		S, (P)	(1)				Small colonies
<i>Filicrista</i> sp.....		C, (P)	(1)				Small colonies
<i>Phidolopora pacifica</i>		S			P		
<i>Rhynchozoon tumulosum</i>	P, (1)						
<i>Scrupocellaria diogenis</i>	P, (1)			1			A small colony
<i>Scrupocellaria</i> sp.....			[1]	P			A small colony
Tubuliporidae.....							Small colonies
<i>Cheilosomatata</i>	[P]						
Phoronida.....	P						
Brachiopoda.....							
<i>Terebratalia transversa</i>	[S]						
<i>Terebratulina unguicula</i>	[4]		C, (6)	C			Attached to algae

Echinodermata						
<i>Amphipholis pugelana</i>						
<i>Ophiotrix apiculata</i>						
<i>Dermasterias imbricata</i>						
<i>Henricia lentuscula</i>						
<i>Patiria miniata</i>						
<i>Cucumaria</i> sp.....						
<i>Parastichopus californicus</i>						
<i>Parastichopus parvimenis</i>						
<i>Strongylocentrotus franciscanus</i>						
<i>Strongylocentrotus purpuratus</i>						
Ascidacea						
<i>Didemnum carinulatum</i>						
<i>Eudistoma</i> sp.....						
<i>Polyclinum planum</i>						
<i>Sigillinaria aequali-siphonis</i>						
<i>Styela montereyensis</i>						
<i>Trididemnum opacum</i>						
ascidian unid.....						
VERTEBRATA						
<i>Paralabrax clathratus</i>						
<i>Gaulotilus princeps</i>						
<i>Embiotoca jacksoni</i>						
<i>Chromis punctipinnis</i>						
<i>Pimelometopon pulchrum</i>						
<i>Orzylus californica</i>						
<i>Coryphopterus nicholsi</i>						
<i>Sebastes atrovirens</i>						
<i>Sebastes dalli</i>						
<i>Sebastes miniatus</i>						
<i>Sebastes serranoides</i>						
<i>Sebastes vexillaris</i>						
<i>Artedius lateralis</i>						
<i>Artedius</i> sp.....						
<i>Scorpaenichthys marmoratus</i>						
<i>Rathbunella hypoplecta</i>						

* Abundance symbols:

P = Present in the area but relative abundance not estimated.

S = Sparse—widely scattered throughout the area but nowhere numerous.

C = Common—unevenly present throughout the area and only occasionally numerous.

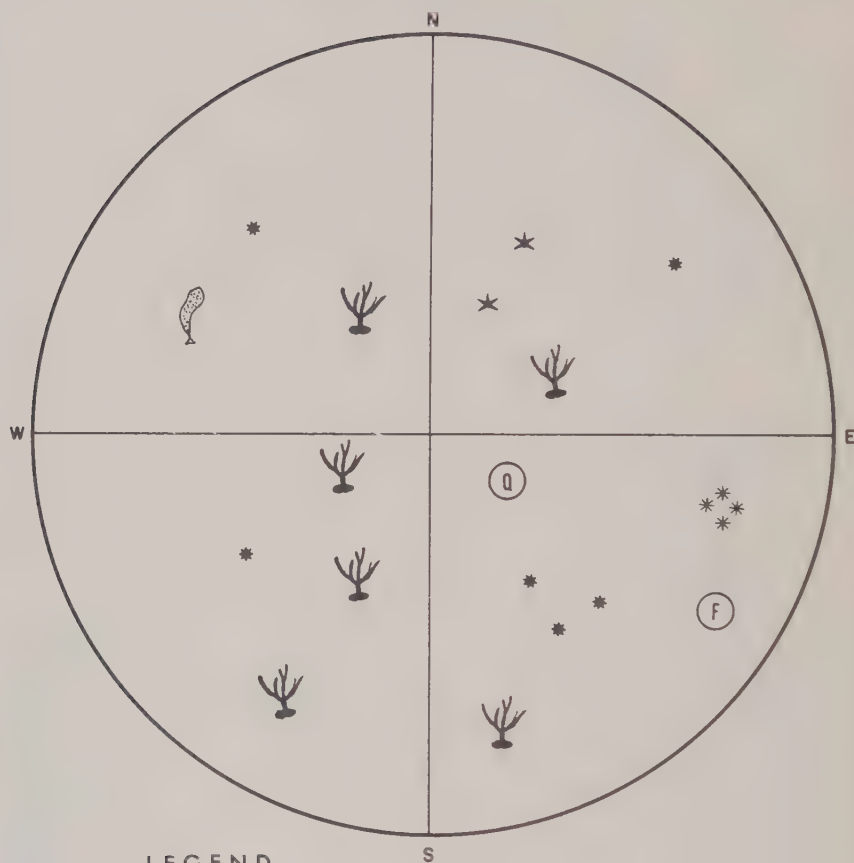
A = Abundant—numerous and evenly distributed throughout the area.

[] = Brackets around the abundance symbol indicate occurrence within the quadrat; 0.25 m on a side.

() = Parentheses around the abundance symbol indicate occurrence within the arc study area.

"Clumped" within small depressions
intertidallyGrowing on algae
A small pieceGrowing on algae at station B
Fragments8 to 12 inches long
20 inches long
8 to 10 inches long
2 to 12 inches long
10 to 30 inches long
6 to 8 inches long5 to 7 inches long
8 to 12 inches long
8 to 12 inches long
10 to 14 inches long1½ inches long
14 inches long

STATION 1-A



LEGEND

- (F) foram sample
- (Q) quadrat sample
-  *Lophogorgia chilensis*
-  *Henricia leviuscula*
-  *Corynactis californica*
-  *Paracyathus stearnsi*
-  *Laminaria farlowii*

FIGURE 11 A pictorial representation of the arc study area, Station 1-A (approximately 30 square meters of bottom area), 100-foot depth, depicting the more obvious biotic features and the sampling locations.

the rock fissures. Low rock shelves and scattered boulders were common. Low-growing coralline and brown algae predominated and some elk kelp (*Pelagophycus porra*) was recorded in the area. These elk kelp plants all showed the effects of grazing. The arc study area was

relatively barren and not characteristic of the general station area (Figure 10) where 8 algae and 39 animals (including 3 fishes) were recorded (Table 1). A few red abalones (*Haliotis rufescens*) were observed, including one 8½ inches long.

Even at the 100-foot depths, this northern transect was characterized by pavement-like base rock and eroded channels filled with shelly debris. Five algae and 60 animals (including 10 fishes) were recorded; elk kelp and ribbon kelp (*Laminaria farlowii*) were the dominant algae (Table 1). The gorgonian *Lophogorgia chilensis* and the stony coral *Paracyathus stearnsi* were dominant in the arc study area (Figure 11). Only one abalone, a large adult red, was recorded in the area.

About 100 feet seaward of our arc study area the bottom gradient dropped off more rapidly at the uplifted seaward edge of this rocky terrace. At the terrace's sheer face, fishes were numerous and diversified. A detailed study of this area, beyond the scope of this present investigation, may reveal important information about changes in these animal communities.

Transect II

In general, Transect II (Figure 2) was characterized by a pavement-like mudstone-siltstone and sandstone base overlain with cobbles and boulders in the nearshore and mid-depths. In the deeper portions of the transect (80- and 100-foot depths), the pavement-rock was deeply incised and ledges and pinnacles formed several high-relief areas. Beyond the 100-foot depths (the limit of this study) the bottom was fine gray sand.

Transect II began at the base of the steep seacliffs, below the U.S. Navy Electronics Laboratory's seawater pumping station. It crossed the broad (190-foot wide) intertidal shelf of low, flat, deeply-incised sandstone. The numerous tide pools in this area supported a lush biota of surf grass, algae, and animals (Table 2). Seaward, an extension of these shelves formed a shallow reef a few hundred feet offshore.

In the 20-foot depths (Station II-E), seaward of this reef area, the lush surf-grass beds diminished and the low rocky shelves and ledges were replaced by cobbles and small boulders, nearly all covered with a crustose red alga, *Lithothamnium* sp. Surf grass, eight algae and seven animals (including two fishes) were observed. Among these were eight adult green abalones (*Haliotis fulgens*) (Table 2). The coralline alga *Corallina officinalis* was dominant in the arc study area (Figure 12).

The 40-foot depths (Station II-D) were infested with red and purple sea urchins, omnipresent across the heavily bored mudstone base rock and around the scattered boulders (Figure 13). Only the hardiest coralline algae (i.e., *Calliarthron regenerans* and *Corallina officinalis*) were present in any quantity. Other species were presumably grazed away by these sea urchin hordes. The arc study area (Figure 14) typified the general area. Four algae and 45 animals (including 8 fishes) were observed (Table 2). Of particular interest, to us, was our finding numerous yellowfin fringeheads (*Neoclinus stephensae*) at this station. This relatively rare fish was ubiquitous in the empty pholad and *Lithophaga* holes honeycombing the mudstone base rock. We have not encountered such concentrations of this fish in any other area.

TABLE 2
Plants and Animals Recorded from Transect II, Point Loma, February 16-18, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
ALGAE							
<i>Enteromorpha</i> sp.						S, [S]	Seen in the mid-tidal zone
<i>Ulva</i> sp.						S, [1]	Seen in the mid-tidal zone
<i>Colpomenia sinuosa</i>						C, [2]	Seen from the mid-tidal to lower tidal zone
<i>Cydoseira oemundacea</i>					P, (2)	P	
<i>Dictyopteris zonarioides</i>		C, (1)	(1)		C	P	Dominant alga at station B
<i>Dictyota flabellata</i>						P	Seen in the lower tidal zone
<i>Egria laevigata</i>					P	P, [1]	
<i>Eisenia arborea</i>					P, (6)		Heavily grazed by <i>Norrisia</i>
<i>Laminaria farlowii</i>		(1)	(1)		F, (2)		All small plants
<i>Pterygophora californica</i>						P	Seen from the low tidal to mid-tidal zone
<i>Sargassum agardhianum</i>						P	
<i>Bossiella orbigniana</i>		P	[P]	[1] C		P, [C]	A large "clump" at station D
<i>Calliarthron regenerans</i>							Most common alga
<i>Corallina gracilis</i>						P	
<i>Corallina officinalis</i>		(S), [1]		S, (1)	P, (A)	C, [C] [1]	
<i>Cryptopleura crispata</i>							A small specimen
<i>Drouesia pellata</i>							
<i>Gelidium cartilagineum</i>	C					P	Seen in the mid-tidal zone
<i>Gelidium nudifrons</i>						P	Seen in the lower tidal zone
<i>Gelidium</i> sp.						P	
<i>Gigartina canaliculata</i>					P	C	
<i>Gigartina serrata</i>							
<i>Gigartina</i> sp.						P	
<i>Laurencia diegoensis</i>						[P]	
<i>Lithothamnium</i> sp.					C, (C), [P]		Encrusting most cobbles and smoothish boulders
<i>Placodium pacificum</i>						P, [1]	
<i>Pterocladia pyramidalis</i>						1	
<i>Rhodomenia pacifica</i>							
<i>Taenioma</i> sp.				[P]		C	A tiny filamentous epiphyte
coralline unid.							Seen from the low tidal to mid-tidal zone
<i>Phyllospadix torreyi</i>					P	A	A flowering plant

INVERTEBRATA and ASCIDIACEA					
	(P)	[C]	[A]	P,[C]	Attached to algae
Protozoa					
<i>Gromia oviformis</i> -----					
Porifera					
<i>Adocia</i> sp.-----	1				A large, branched colony
<i>Azinella mexicana</i> -----	P			P	Seen in the low tidal zone
<i>Cranella</i> arb.-----	P				Large specimens
<i>Goodia mesotriena</i> -----	C			[1]	Large specimens
<i>Haliclona</i> sp.-----					A small piece growing on a coralline alga
<i>Hemectyon hyle</i> -----					A small "piece"
<i>Leuconia barbata</i> -----	1				A 2-by 4-inch colony
<i>Selletia estrella</i> -----					A large "piece"
<i>Sycon</i> sp.-----	1,(1)	[1]			
<i>Tethya aurantia</i> -----	P	C,(1)			
<i>Trikentrion flabelliformis</i> -----	[P]				Only two "leaves"
Cnidaria					
<i>Anthopleura xanthogrammica</i> -----					Seen in the mid-tidal zone
<i>Astrangia lajollaensis</i> -----					
<i>Balanophyllia elegans</i> -----					
<i>Corynactis californica</i> -----	C	15/16m ² ,(C)	[2]		A small aggregation at station C
<i>Eugorgia rubens</i> -----	S	[5]			
<i>Eugorgia chilensis</i> -----	C	(S)			
<i>Muricea californica</i> -----	P,(1)				To 6 inches high
<i>Paracyathus stearnsi</i> -----					
<i>Stylatula</i> sp.-----	A	P,(2),[1]	[1]		
zoantharian, white unid.-----	C,(3)	(S)			
Platyhelminthes					
Nemertina	(11)	(P)			
Nematoda					
Annelida					
Amphionidae					
Capitellidae					
<i>Phyllochaetopterus prolifica</i> -----					
Chrysopetalidae					
<i>Glaetozona corona</i> -----					
<i>Tharyx</i> sp.-----	(14)	(3)			
cirratulid unid.-----					
<i>Poecilochaetus johnsoni</i> -----	(2)	(3)			
Flabelligeridae	(24)	(1)			
<i>Glycera</i> sp.-----	(1)	(1)			
<i>Ophiodromus pugettensis</i> -----	(4)	(5)			
hesionid unid.-----			[1]		Several white polyps extending up from a basal mass

TABLE 2—Continued
Plants and Animals Recorded from Transect II, Point Loma, February 16-18, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
<i>Lumbrineris</i> sp.-----	((3))	((2)) P	((5))				
<i>Nephtys</i> sp.-----	((1)) P						
<i>Nereis procer</i> -----						[4]	
nereid unid.-----							
<i>Diopatra ornata</i> -----	C, (10)/ $\frac{1}{4}$ m ²						
onuphid unid.-----	((2))						
Phyllodoidea-----	((1))	P, ((10)) P	[2], ((7)) [4]	[1]			
Polynoidae-----	P						
<i>Chone</i> sp.-----	((1))						
salvelliid unid.-----							
<i>Salmarina tribranchiata</i> -----		P	P	[2]		[C]	
serpulid unid.-----							
<i>Polydora</i> sp.-----			((1))				
<i>Prionospio pygmaeus</i> -----	((6))		((3))				
<i>Prionospio</i> sp.-----							
spionid unid.-----			((2)) ((1))			[5]	
<i>Sphaerodorum</i> sp.-----							
<i>Exogone</i> sp.-----							
<i>Syllis</i> sp.-----		((1)) ((1))					
<i>Trypanosyllis</i> sp.-----							
syllid unid.-----			[1] ((14))			[3]	
<i>Oligochaeta</i> unid.-----							
Arthropoda-----							
Ostracoda-----	((2))						Seen in the mid-tidal zone
<i>Citharus fissus</i> -----						[1] P	Seen in the mid-tidal zone
<i>Pollicipes polymerus</i> -----						P C	Seen from the low tidal to mid-tidal zone
<i>Tetrachia squamosa rubescens</i> -----							
<i>Cumella</i> sp.-----							
cumacean unid.-----	((1))		[1]	[1]		P, [1] [2] [9]	Pinkish coloration
Tanaidacea-----			[9], ((P)) [1]	[9]			
<i>Cirrolana harfordi</i> -----							
cirrolanid unid.-----		((1))					
Arcturidae-----	((1))						

(4)	P, (1)	(2) [S]	[A] [S]	A	
Gammaridea-----					
Caprellidea-----	P			P	Under rocks
Epialtoides hilloni-----				[1]	In crevice
Lophopanopeus bellus-----				[P]	
Lophopanopeus lockingtoni-----	P				
Pachycheles sp.-----					
Pandatus gurneyi-----		10/m ²		[1]	Seen in the mid-tidal zone
Panulirus interruptus-----		1		P	
Pelia clausa-----				[2]	
Petrolisthes sp.-----				P	
Pugetia dalli-----	P	[1]		[P]	
Pugetia producta-----					
Pycnogonida-----		[1]			
Mollusca-----					
Ocenebra bimaculatus-----				P	Seen in the mid-tidal zone
Cyanoplax sp.-----				[3]	
Ischnochiton fallax-----		[3]			
Ischnochiton mertensii-----		[1]	[1]		
Mopalia ciliata-----				P	
Nuttallina californica-----				P	
chitons unid.-----				P	
Acmaea fenestrata-----				[1]	
Acmaea paleacea-----				P	
Acmaea scabra-----				P	
Acmaea triangularis-----					
Acmaea sp.-----					
Acteocina culcitella-----	(1)			C	
Alabina tenuisculpta-----				[4]	
Alvania acutilirata-----	(1)				
Amphissa versicolor-----		[1]			
Anachis penicillata-----					
Anisodoris nobilis-----		P			
Aplysia californica-----					
Balcis rutila-----			1	P, [3]	Parasite on <i>Astropetelen</i>
Burchia radonensis-----					
Cadlina flavomaculata-----	[1]				
Cadlina limbaughi-----	P, (1)	C, (2)			
Cadlina marginalis-----		C, (1)	(1)		
Caecum dalli-----		[3]			
Calliostoma annulatum-----	P				
Calliostoma gloriosum-----					
Calliostoma supragranosum-----	P				
Calliostoma tricolor-----			[1]		

TABLE 2—Continued
Plants and Animals Recorded from Transect II, Point Loma, February 16-18, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
<i>Cerastostoma nuttallii</i>							
<i>Cerithiopsis carperieri</i>							
<i>Conus californicus</i>	P		[2]	[1] S, [1]		P [1] P, [1]	Juvenile specimens in the intertidal Attached to <i>Eurchia</i>
<i>Crepidula onyx</i>	2					1	
<i>Crenipatella lingulata</i>			[4]	[5]			
<i>Dendrodoris albopunctata</i>		P, (1)					
<i>Dialia acuta</i>		P					
<i>Diaulula sandiegensis</i>							
<i>Diodora murina</i>							
<i>Epitonium</i> sp.....						[55]	Tiny specimens
<i>Fissurella volcano</i>							
<i>Flabellina iodinea</i>	P	P, (1)	P			P 1 P, [2]	
<i>Haliotis fulgens</i>							
<i>Hermisenda crassicornis</i>							
<i>Kelletia kelletii</i>	P	C, (3)	P, (1)	P C	S, (2)	P	
<i>Lacuna unifasciata</i>			((1))				Small specimens
<i>Liola fenestrata</i>						C, [12]	
<i>Littorina planaxis</i>							
<i>Littorina scutulata</i>						P	Seen in the upper tidal zone
<i>Lottia gigantea</i>						P	Seen in the upper tidal zone
<i>Macron lividus</i>						P	
<i>Marginella</i> sp.....			[1], ((1))			[1]	
<i>Megascarcia remondii</i>	2	3	P		2	P	
<i>Megachura crenulata</i>	((1))		[2], ((1))			[6]	Tiny specimens
<i>Micranellum erubescens</i>				S			
<i>Mitra idae</i>						[117]	
<i>Mitrella gouldii</i>							
<i>Mitrella tuberosa</i>			[2]				
<i>Mitrella</i> sp.....			[1]			P	
<i>Nassarius mendiculus</i>							
<i>Norrista norristi</i>							
<i>Odostomia</i> sp.....							
<i>Olivella bartica</i>	P	((2))		[1]	C, (C)	P	Grazing on <i>Eisenia</i> at station D

Species	Locality	Depth	Specimens
<i>Seila montereyensis</i>			
<i>Serpulorbis squamigerus</i>			
<i>Tegula aureotincta</i>			
<i>Tegula funebris</i>			
<i>Tegula lipulata</i>			
<i>Tegula</i> sp.....			
<i>Tricolia compla</i>			
<i>Triopha maculata</i>			
<i>Zonaria spadicea</i>			
<i>Arcuatula demissa</i>			
<i>Chaceta ovoides</i>			
<i>Chama pellicuda</i>			
<i>Cumingia californica</i>			
<i>Ervilia californica</i>			
<i>Glaux carpenteri</i>			
<i>Hiatella arctica</i>			
<i>Hinnites multirugosus</i>			
<i>Homomya adamistana</i>			
<i>Kellia taperous</i>			
<i>Leptopecten latiaurata</i>			
<i>Lima hemphilli</i>			
<i>Lithophaga subula</i>			
<i>Lucinoma</i> sp.....			
<i>Modiolus capax</i>			
<i>Mytilus californianus</i>			
<i>Mytilus edulis</i>			
<i>Parapholas californica</i>			
<i>Penitella penita</i>			
<i>Ectoprocta</i>			
<i>Cellaria mandibulata</i>			
<i>Costazia robertsoniae</i>			
<i>Diaperoecia californica</i>			
<i>Hippodiplosia insculpta</i>			
<i>Phidolopora pacifica</i>			
<i>Rhynchozoon tumulosum</i>			
<i>Brachiopoda</i>			
<i>Terebratalia transversa</i>			
<i>Terebratulina unguicula</i>			
<i>Echinodermata</i>			
<i>Amphipholis pugelana</i>			
<i>Amphitura diastata</i>			
<i>Ophioneureis annulata</i>			

TABLE 2—Continued
Plants and Animals Recorded from Transect II, Point Loma, February 16–18, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
<i>Ophiopleris papillosa</i>			[6]				
<i>Ophiathrix rudis</i>			[7]				
<i>Ophiathrix spiculata</i>	(2))	C	(2)) P	A, [8] [1]		[2]	Juvenile specimens
<i>Ophiuroida unid.</i>							
<i>Astrometis verticifera</i>	P, (5)						
<i>Astropecten verrilli</i>							
<i>Dermasterias imbricata</i>		(1)	P, (1)				
<i>Henricia leviuscula</i>		P, (1)	P, (1), [1] P				
<i>Linckia columbiana</i>							
<i>Petalaster foliolata</i>	(1) P						
<i>Mediaster aequalis</i>							
<i>Patiria miniata</i>							
<i>Pisaster giganteus</i>		P C	P P	C, (2)		1	Seen in the mid-tidal zone
<i>Parastichopus parvimenis</i>	P						
<i>Thyonopsois nuttiana</i>							
<i>Lytechinus anamesus</i>	P, (8)	(3)	5/m ² , 5, [2], (1)) C			[1]	
<i>Strongylocentrotus franciscanus</i>							
<i>Strongylocentrotus purpuratus</i>				20/m ² , (16) 2/m ² , (2) [1]			Juvenile specimens A tiny juvenile specimen
<i>Strongylocentrotus</i> sp.		P				[1]	
Centrarchinoidea.....		(1))					
Ascidacea.....							
<i>Cystodites lobatus</i>							
<i>Eudistoma</i> sp.		P	C				Large masses present
<i>Pyura haustor</i>		P					Small, lobate specimens
<i>Styela montereyensis</i>		P					Small specimens
<i>Trididemnum opacum</i>							
ascidian unid.		[1]	S (1)		1		

VERTEBRATA

<i>Gymnothorax mordax</i> -----	1	10	2		About 30 inches long
<i>Paralabrax clathratus</i> -----	10	10			3 to 14 inches long
<i>Paralabrax nebulifer</i> -----	1	10	75		14 to 20 inches long
<i>Girella nigricans</i> -----	30	10		6	18 inches long at Station B
<i>Embiotoca jacksoni</i> -----	1	1			4 to 12 inches long
<i>Rhacochilus toxotes</i> -----	300+	50			16-inch specimens
<i>Chromis punctipinnis</i> -----	100+	100+		100+	3 to 9 inches long
<i>Oxyulis californica</i> -----	40	40			
<i>Pimelometopon pulchrum</i> -----	100+, (4)	30, (2)	10, (2)		4 to 36 inches long
<i>Coryphopterus nicholsi</i> -----					2 to 5 inches long
<i>Scorpaena guttata</i> -----	5	3			
<i>Sebastes atrovirens</i> -----	7	5			
<i>Sebastes miniatus</i> -----		1	1		5 to 7 inches long
<i>Sebastes serranoides</i> -----			6/m ² , (2)		2 to 3 inches long
<i>Sebastes serripes</i> -----			1		1½- to 2 inches long
<i>Sebastes vexillaris</i> -----			1		1½-inches long
<i>Oxyplebius pictus</i> -----		10			1 inch long
<i>Artedius lateralis</i> -----					3 to 4 inches long
<i>Artedius</i> sp.-----	C				
<i>Gobiosox thessodon</i> -----					
<i>Cryptotrema corallinum</i> -----					
<i>Neoclinus stephensae</i> -----					
<i>Rathbunella hypoplecta</i> -----		15	35+, (3)		
<i>Rathbunella</i> sp.-----	25				

* Abundance symbols:

P = Present in the area but relative abundance not estimated.

S = Sparse—widely scattered throughout the area but nowhere numerous.

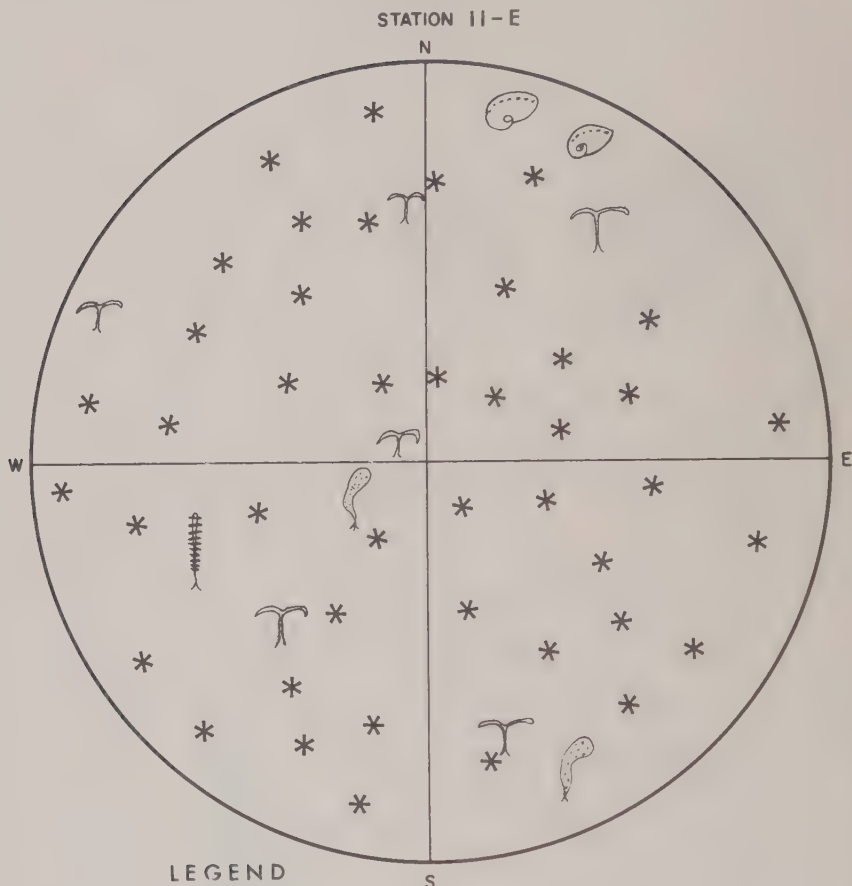
C = Common—unevenly present throughout the area and only occasionally numerous.

A = Abundant—numerous and evenly distributed throughout the area.

[] = Brackets around the abundance symbol indicate occurrence within the quadrat; 0.25 m on a side.

() = Parentheses around the abundance symbol indicate occurrence within the arc study area.

() = Double parentheses around the abundance symbol indicate occurrence in the polychaete sample.



LEGEND

- * *Corallina officinalis*
-  *Laminaria farlowii*
-  *Eisenia arborea*
-  *Haliotis fulgens*
-  *Egregia laevigata*

FIGURE 12 A pictorial representation of the arc study area, Station II-E (approximately 15 square meters of bottom area), 20-foot depth, depicting the more obvious biotic features.

The 60-foot depths (Station II-C) were just seaward of a high relief ridge. Here the bottom was still pavement rock but numerous ledges and boulders were nearby (Figure 15). Although giving the appearance of harboring an impoverished biota, possibly due to the lack of large floral and faunal growths, 4 algae and 88 animals (including 13



FIGURE 13 The sparse biota and omnipresent sea urchins at Station II-D (40-foot depth).
Photo by Charles H. Turner.

fishes) were recorded, making this one of the more lush areas surveyed during this study (Table 2). Sea urchins were present but not in the concentrations observed at Station II-D. White sea urchins (*Lytechinus anamesus*) replaced the purple and red sea urchins which were dominant in the shallows (Figure 16). The ledges and crevices were relatively free from sand and debris, offering an area of concealment for spiny lobsters (*Panulirus interruptus*), observed only at this station.

The bottom relief increased in height at the 80-foot depths (Station II-B) and 10- to 15-foot high ledges and pinnacles were encountered. Most of these appeared to be tilted upward at their seaward edge, and all terminated in a sheer face. Algae remained sparse but the animals were numerous and diversified. In all, 4 algae and 61 animals (including 15 fishes) were recorded (Table 2). White sea urchins were present but only in limited numbers. The arc study area (Figure 17) typified the general area and its biotic assemblage.

The 100-foot depths (Station II-A) represented the seaward edge of the broad mudstone-siltstone and sandstone shelf lying offshore of Point Loma. At this point (approximately 2,100 yards offshore), the shelf deteriorated into pinnacles and boulders randomly scattered on broad areas of sand. A few hundred feet seaward the bottom became pure sand with ripple marks the only relief. Our Station II-A was on a broad expanse of medium gray sand (uniform throughout the entire 8-inch core) in close proximity to large pinnacles and rocky outcrops (30 to 60 feet west). Only 18 animal species were recorded within the

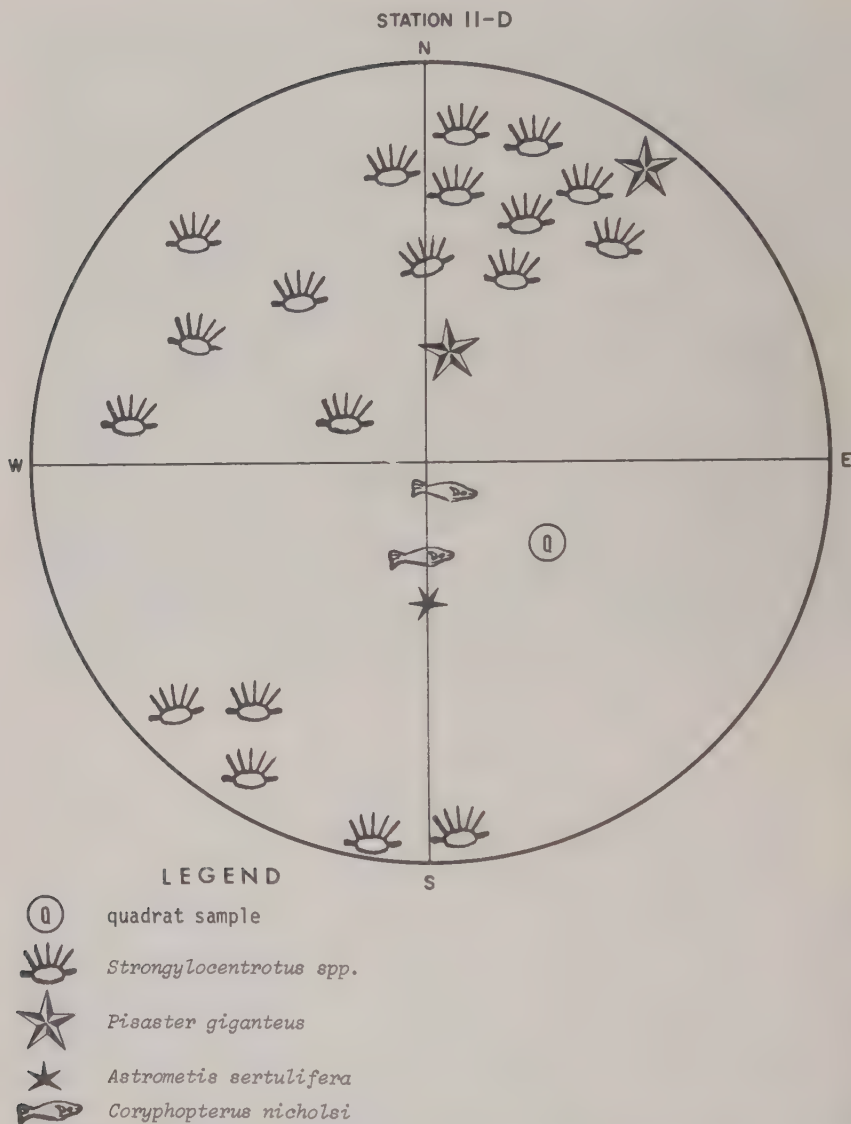


FIGURE 14 A pictorial representation of the arc study area, Station II-D (approximately 15 square meters of bottom area), 40-foot depth, depicting the more obvious biotic features and the sampling locations.

are study area: the others an alga and 34 animals (including 3 fishes) were associated with these nearby rocks (Table 2). The arc study area (Figure 18) illustrates the sand dwellers.



FIGURE 15 A rocky ledge and its epibiose, typical of Station II-C (60-foot depth). Photo by Charles H. Turner

Transect III

Pursuing a course directly seaward (255° magnetic) from the sewage treatment plant outfall base, this transect (Figure 2) terminated in the 100-foot depths approximately 2,850 yards offshore. Its narrow intertidal zone, backed by steep, often overhanging cliffs, consisted of low sandstone shelves, shallow surge channels and a few small tidepools. Low-growing green (Chlorophyta) and red (Rhodophyta) algae were abundant, and surf grass formed a moderate bed in the low tidal zone. Numerous chitons (*Amphineura*) and limpets (*Acmaea* spp.) were present in the crevices and depressions and several tiny snails and crustaceans occurred throughout the transect (Table 3).

Seaward, the low reefs and prominent surge channels effected such turbulent surf conditions and reduced visibility that our diving observations and collections were severely curtailed even at the 20-foot depth (Station III-E), approximately 700 yards offshore. Here the low shelves were covered by a thick accumulation of coarse red sand. The only organisms identified came from the polychaete sample.

The bottom in the 40-foot depths (Station III-D) consisted of relatively flat, pavement-like sandstone. The numerous boulders observed appeared out-of-place and may have been rip-rap associated with the nearby outfall pipe.

The substantial bed of adult giant kelp contained numerous juvenile plants. Again, surge and restricted visibilities hampered our general survey, however, an extensive invertebrate fauna was recorded

(Table 3). No fishes were seen and low-growing red algae appeared dominant.

Fathometer traces indicate an irregular bottom between Stations D and C with at least three distinct terraces (Figure 2), each covered

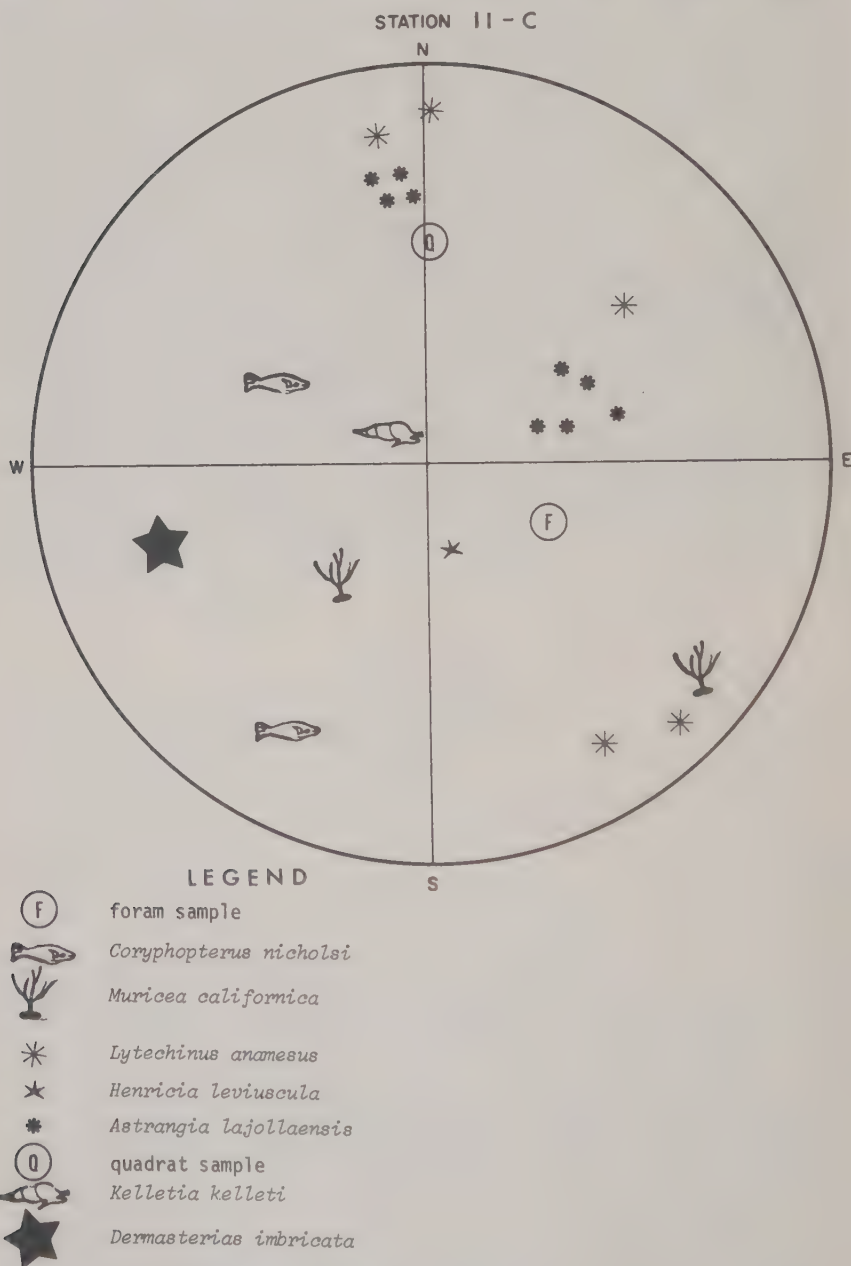


FIGURE 16 A pictorial representation of the arc study area, Station 11-C (approximately 15 square meters of bottom area), 60-foot depth, depicting the more obvious biotic features and the sampling locations.

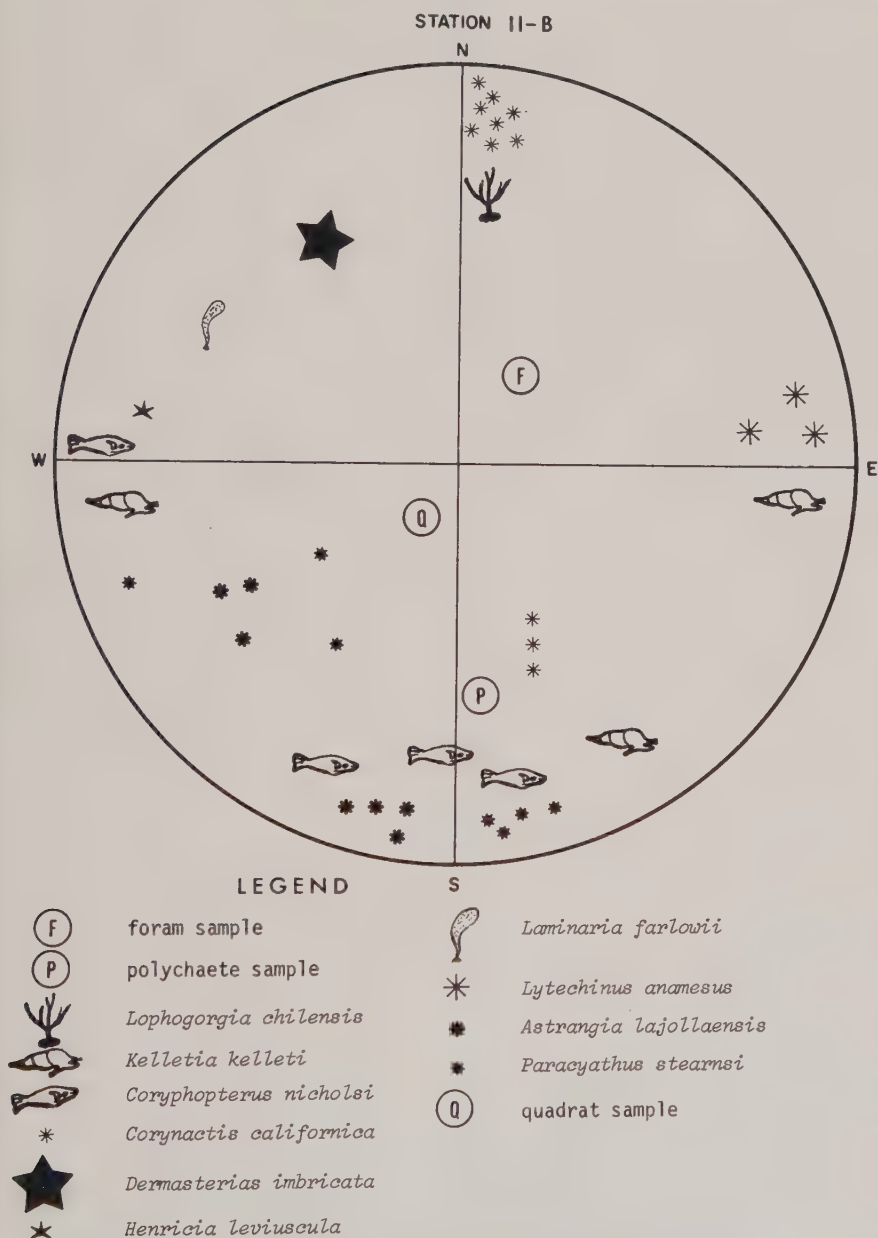
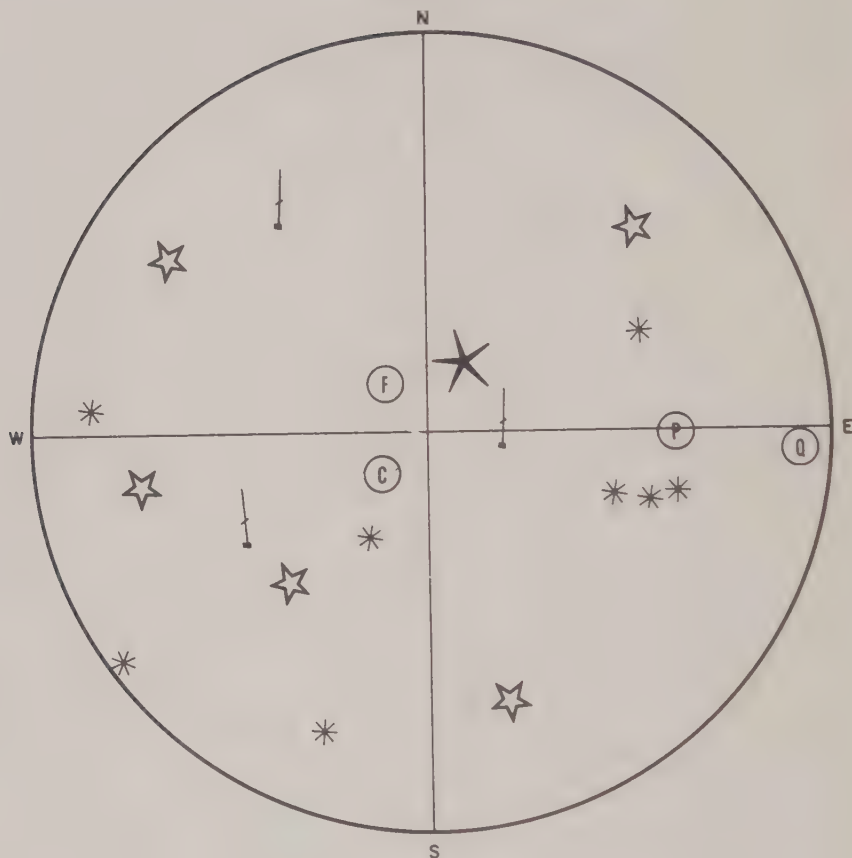


FIGURE 17 A pictorial representation of the arc study area, Station 11-B (approximately 15 square meters of bottom area), 80-foot depth, depicting the more obvious biotic features and the sampling locations.

STATION 11-A



LEGEND

- | | |
|----------------------------------|--------------------|
| (C) core | (Q) quadrat sample |
| (P) polychaete sample | (F) foram sample |
| * <i>Lytechinus anamesus</i> | |
| ★ <i>Petalaster foliolata</i> | |
| ☆ <i>Astropecten californica</i> | |
| ⌋ <i>Stylatula</i> sp. | |

FIGURE 18 A pictorial representation of the arc study area, Station 11-A (approximately 15 square meters of bottom area), 100-foot depth, depicting the more obvious biotic features and the sampling locations.

with scattered giant kelp plants which combine to form a continual surface canopy.

The 55-foot depths (Station III-C), about 2,450 yards offshore, were characterized by pavement-like sandstone without boulders. An increase in the floral and faunal assemblages was readily apparent when we

TABLE 3
Plants and Animals Recorded from Transect III, Point Loma, February 16, March 8 and 9, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
ALGAE							
<i>Codium setchellii</i>		5	3			P	Seen near the low tidal zone
<i>Euteromorpha</i> sp.....						P	Small plants
<i>Cystoseira osmundacea</i>		P				P	
<i>Dictyota zonarioides</i>						P	
<i>Egregia laevigata</i>							Seen at the low tidal zone
<i>Laminaria farlowii</i>	S		C				Small plants at station A
<i>Macrocystis pyrifera</i>		S, (1)	C, (2)	C			Moderate beds at stations C and D
<i>Pelagophycus porra</i>		C, (3)	1/4m, 1(1)				Extend to within 10 feet of surface; appear healthy
<i>Pterogophora californica</i>			C				
<i>Amphisiphonia pacifica</i>		[P]					Scattered "clumps" at station C
<i>Boswellia orbigniana</i>	S	[C]	S, [P]				
<i>Calliarthron regenerans</i>	S		P				Small specimens
<i>Calliophyllis marginifraga</i>			[2]			[1]	Scattered "clumps" at station C
<i>Coralina officinalis</i>		C, [1]	S, [S]			P	Seen near low tidal zone
<i>Gelidium purpurascens</i>							A small specimen
<i>Gigartina volans</i>							
<i>Gigartina</i> sp.....							Seen at the low tidal zone
<i>Lithothamnium</i> sp.....		[P]		P			Encrusting rocks
<i>Microcladia</i> sp.....	A						
<i>Peyssonetia rubra</i>		[P]					
<i>Plocamium pacificum</i>	A						
<i>Pterocladia pyramidalis</i>							
<i>Rhododymenia arborescens</i>	C					[1]	
<i>Rhododymenia pacifica</i>			C				
<i>Rhododymenia</i> sp.....		A, (S), [5]					
coralline unid.....	P, (C)	(P)	(P)	A			
<i>Phyllospadix torreyi</i>						P, [P]	A flowering plant

TABLE 3—Continued
Plants and Animals Recorded from Transect III, Point Loma, February 16, March 8 and 9, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
INVERTEBRATA AND ASCIDIACEA							
Protozoa							
<i>Gromia oniformis</i>	(11)	[C] [1]	[C]	[C], (11)		[S]	Attached to coralline algae
<i>Miniacina minacea</i>							
Porifera							
<i>Acanus erihacus</i>	(C)	(C)					Thin growth form; almost encrusting
<i>Azinella mexicana</i>	(C)	(P)	(P)				Large specimens at station A
<i>Craniella arb.</i>	C	P					A small fragment
<i>Cyamon</i> sp.....		[1]					Large specimens
<i>Geodia mesotridena</i>	C, (1)						
<i>Haliciona lunisimilis</i>	(1)						
<i>Haliciona</i> sp.....	(C)	(P), [C]	(P), [C]				Grayish, amorphous sponge
<i>Hymenaphysastra cyanocorypha</i>							
<i>Leuconia barbata</i>							
<i>Leucosolenia bolryoides</i>		[S]		P			A few small "pieces"
<i>Lissodendoryx noxia</i>		[P]					A small "patch"
<i>Pleuromia karykina</i>		[1]	[1]				A small "piece"
<i>Prianos problematicus</i>		[S]					Small "clumps"
<i>Sycon</i> sp.....		[S]		P, [C]			Large specimens
<i>Tedania topeanti</i>		(P), [1]	(P)				A small "piece"
<i>Tethya aurantia</i>	C, (C)						Several colonies
<i>Triaktrion flabelliformis</i>	(2)	[1]					Seen near the low tidal zone
sponge, encrusting yellow, unid.....							
Cnidaria							
<i>Plumularia setacea</i>		[1]	[C]				
<i>Plumularia</i> sp.....							
<i>Anthopleura xanthogrammica</i>							
<i>Astrangia lajollaensis</i>	C	P, [1]					
<i>Balanophyllia elegans</i>	C, (S)	(P), [1]	10/¼ m ² , [3]				
<i>Cerianthopsis</i> sp.....		1	C, (10/¼ m ²), [2]				
<i>Corynactis californica</i>	P, S						

TABLE 3—Continued
Plants and Animals Recorded from Transect III, Point Loma, February 16, March 8 and 9, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
<i>Sphaerosyllis</i> sp.-----				(11)			
syllid unid.-----		[9]	[1]	[1]			
Sipunculida-----			[1]				
Arthropoda-----							
Mysidacea-----			[1]	(11)			
<i>Bodotria</i> sp.-----		[1]					
<i>Cumella</i> -----		[3]	[8]	[5]		[13]	Pinkish coloration
Tanaidacea-----				(22)			
cirrulanid unid.-----		[5]	[C]	(2)	(2)	[S]	Seen beneath rocks
Anthuridae-----		[5]	[4]	[8]			
Gammaridea-----		[5]	40			[2]	
Caprellidea-----		[5]					
<i>Pandalus gurneyi</i> -----		[5]					
<i>Petrolisthes cinctipes</i> -----		C					
<i>Pugettia dalli</i> -----	S	[3]					
pagurid unid.-----		1					
insecta unid.-----							
Mollusca-----							
<i>Callistochiton palmulatus</i> -----				[1]			
<i>Chaeolopleura gemma</i> -----			[1]				
<i>Cyanoplax dentata</i> -----			[3]				
<i>Cyanoplax</i> sp.-----			[2]				
<i>Dendrochiton</i> sp.-----		[4]	[1]	1			
<i>Acmaea</i> sp.-----		[2]	[1]	1		C	
<i>Acteon punctocollata</i> -----		[1]					
<i>Aegires albopunctatus</i> -----							
<i>Agatholoma densilineata</i> -----							
<i>Alvania acutirata</i> -----				(11)			
<i>Amphissa versicolor</i> -----			[7]	(22)			
<i>Anisodoris nobilis</i> -----		[1]					
<i>Astraea gibberosa</i> -----		P					
<i>Astraea undosa</i> -----		2					
		15					

<i>Bartelia</i> sp.....					[2]	
<i>Bulla gouldiana</i>			P	(1)	[1]	
<i>Cadina limbaughi</i>						
<i>Cadina marginalis</i>						
<i>Caecum dalli</i>	(11)			(11)		
<i>Calliostoma tricolor</i>	[2]		(1), [1]			
<i>Conus californicus</i>	[2]		[1]			
<i>Crepidula nummaria</i>	[8]		[16]			
<i>Crepidatella lingulata</i>	(1), [1]		40, (C)	[4]		
<i>Dendrodoris albopunctata</i>						
<i>Dendronoctus frondosus</i>	1					
<i>Dioda acuta</i>	P					
<i>Dicaulula sandiegensis</i>						
<i>Eptenium</i> sp.....						
<i>Fissurella volcano</i>						
<i>Flabellina todinea</i>	P					
<i>Haliotis rufescens</i>	P					
<i>Hermisenda crassicornis</i>						
<i>Hippomiz tumens</i>						
<i>Kelletia kelletii</i>		(S)	C	[1]		
<i>Lacuna unifasciata</i>						
<i>Margarella jevettii</i>						
<i>Margarella</i> sp.....						
<i>Micranellum crebritinctum</i>						
<i>Mitra catalinae</i>						
<i>Mitrella gouldii</i>						
<i>Nassarius</i> sp.....						
<i>Odosomia donilla</i>						
<i>Odosomia terricola</i>						
<i>Olivella biplicata</i>						
<i>Phidiana pugnax</i>						
<i>Serpulorbis squamigerus</i>						
<i>Tegula funebralis</i>						
<i>Tricolia compia</i>						
<i>Triopha maculata</i>						
<i>Turbonilla chocolata</i>						
<i>Volutella cylindrica</i>						
<i>Zonaria spadicea</i>						
<i>Arcuatula demissa</i>						
<i>Epyritia californica</i>						
<i>Glaucus carpenieri</i>						
<i>Hiatella archica</i>						
<i>Hinnites multirugosus</i>						
<i>Kellia lanerosus</i>						

TABLE 3—Continued
Plants and Animals Recorded from Transect III, Point Loma, February 16, March 8 and 9, 1965
Station and Abundance*

Scientific Name	A	B	C	D	E	Intertidal	Remarks
<i>Leptopecten latiauratus</i>		(S), [1]	C, (C), [C]	1			
<i>Lithophaga subula</i>				2			
<i>Penstella penita</i>		[2]					
<i>Philobrya setosa</i>							
<i>Ectoprocta</i>							
<i>Costazia robertsoniae</i>		(C)	[1]	P			A small colony at station C
<i>Crista occidentalis</i>		(S), [2]					Small colonies
<i>Crista</i> sp.....		[S]					
<i>Diaperoecia californica</i>	[1]	C, [2]	(C)				A small colony
<i>Hippodiplosia insculpta</i>	C	(S), [2]	[C]				A small colony at station C
<i>Parasmittina</i> sp.....				[1]			Growing on most <i>Crepidatella</i> at station C
<i>Phidolopora pacifica</i>		(S)	(1)				Small colonies
<i>Rhynchozoon tumulosum</i>		[C]	[C]	[C]			
<i>Tubulipora</i> sp.....		[1]	[1]				
Brachiopoda							
<i>Terebratalia transversa</i>			P				
Echinodermata							
<i>Amphipholis pugelana</i>		[6]		[3]			
<i>Ophiopertis papillosa</i>		[3]					
<i>Ophiathrix spiculata</i>		[8]					
<i>Ophiuroidea</i> unid.....	(11)		[5]	[1]			
<i>Astrometis sertulifera</i>							
<i>Astropecten verrilli</i>	C, (6)					1	A juvenile specimen Seen near the low tidal zone
<i>Dermasterias imbricata</i>		P					
<i>Henricia leviusecula</i>	(2)	(1)	1				
<i>Patiria miniata</i>	(1)	P, (S)					
<i>Parastichopus parvimenais</i>		5, [1]					
<i>Pentamera</i> sp.....		[1]					
<i>Lytichinus anametus</i>			[1]				A small specimen
<i>Strongylocentrotus franciscanus</i>		10					
<i>Strongylocentrotus purpuratus</i>		8		P			

compared this station's species list with those of previous stations on this transect. Elk kelp was conspicuous, and other brown and red algae also were present. Sixty invertebrates were identified (Table 3), but only four fish species were observed, possibly due to the lack of protective niches in the pavement-like substrate. The arc study area (Figure 19) was typical of our general station findings.

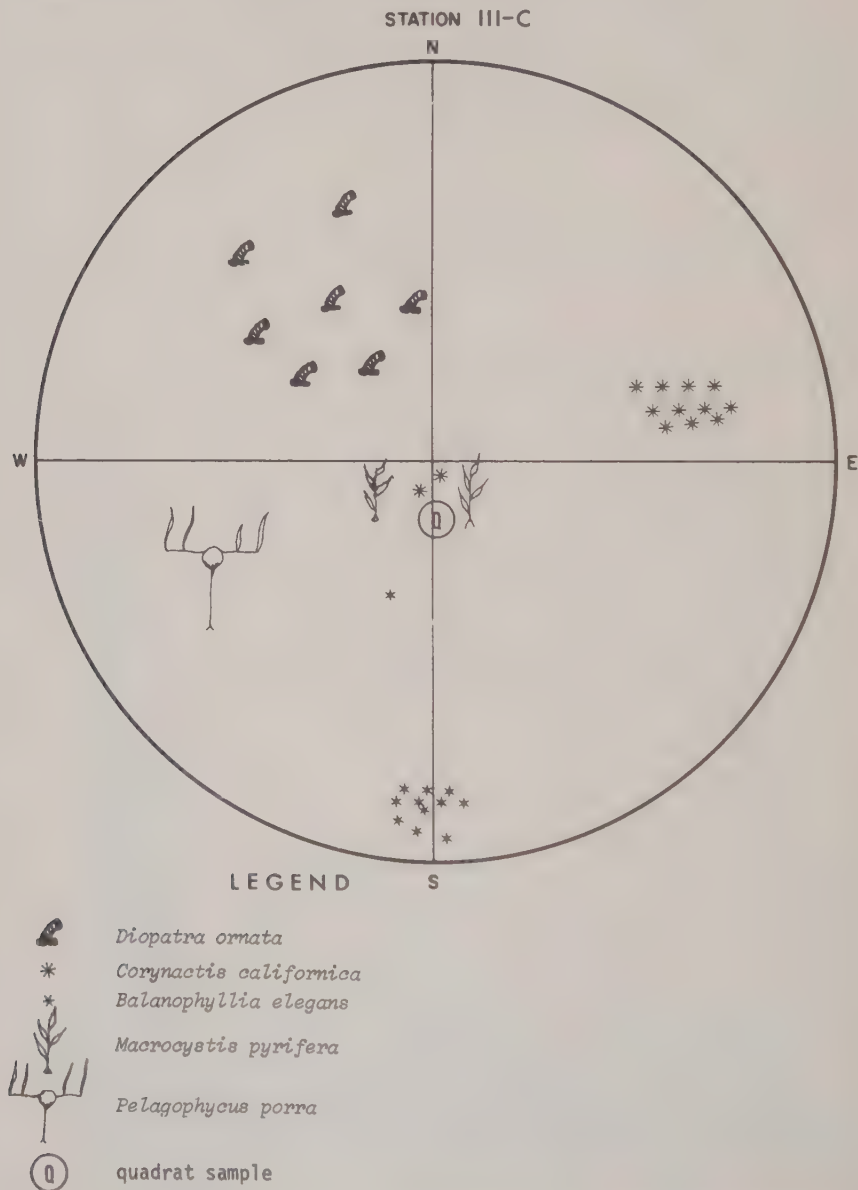


FIGURE 19 A pictorial representation of the arc study area, Station III-C (approximately 15 square meters of bottom area), 60-foot depth, depicting the more obvious biotic features and the sampling locations.

The 75-foot depths (Station III-B) represented the most diverse community organization along this transect. This station, almost 2,700 yards offshore was on sloping pavement-like sandstone. Within 100 feet of our study arc were numerous, large, flat-topped rocky prominences, their sheer and often undercut sides extending 15 to 20 feet above the sea floor. Elk kelp and small red algae, especially *Rhodymenia* sp. were common, but giant kelp was sparse. Ninety-three invertebrates and ascidians were identified, including numerous sponges, stony corals, the gorgonian *Lophogorgia chilensis*, 30 different mollusks, and red and purple sea urchins (Table 3). The arc study area (Figure 20) was representative of this station.

The fish fauna increased here and of the 13 species recorded (Table 3), blacksmiths (*Chromis punctipinnis*) and señoritas (*Oxyjulis californica*) were the most common.

The 100-foot depths (Station III-A) approximate the seaward edge of the Point Loma submerged shelf. Scattered, large, rocky outcroppings were prominent, but interspersed with extensive sandy areas. Here our study arc included both sand and rock. Sand stars (*Astropecten verrilli*) characterized the sandy areas, with low red algae, a large sponge (*Geodia mesotriaena*), and gorgonian corals conspicuous on the rock (Figure 21). Numerous fishes were also encountered (Table 3).

Transect IV

Our most southerly transect (Transect IV), near the southern tip of Point Loma, pursued a seaward course of 255° magnetic. The bottom, as interpreted from fathometer tracings (Figure 2) sloped moderately into 40-foot depths, then became irregular, but without any substantial depth increase, almost to Station IV-C (60-foot depths). Beyond this, it declined sharply, becoming quite irregular. Large pinnacle-like projections appeared, continued a short distance, then sharply graded onto sand (100-foot depths) about 1,900 yards from shore.

The broad (300-foot) intertidal zone of Transect IV was backed by low, vertical sandstone cliffs. Numerous gullies, tide pools, low shelves, and 3- to 4-foot high rocky outcrops provided innumerable habitats for the diverse plant and animal assemblages observed here. Fifty-one species were recorded, including 24 mollusks (Table 4). Sea mussels (*Mytilus californianus*) and stalked barnacles (*Pollicipes polymerus*) formed large dense beds on the upper surfaces of the higher rocky outcrops, while chitons and numerous small crabs predominated on the rock undersides. Near the lower tidal zone and extending seaward into the sub-tidal was a moderate surf-grass bed.

The 20-foot depths (Station IV-E) lie approximately 300 yards offshore. The heavily bored pavement-like sandstone is profuse with cobbles and boulders, and interlaced with numerous, small rifts filled with sand and shelly debris. A 2- to 3-foot high brown alga (*Pterygophora californica*) was abundant and dominant at this station, but was not represented in the arc study area. Strap kelp (*Egregia laevigata*), extending upward to the surface, and low-growing coralline algae were also common (Figure 22). This station is subjected to moderate or strong surge action, so speciation is restricted to those organisms tolerating these harsh conditions (Table 4). No fish were recorded.

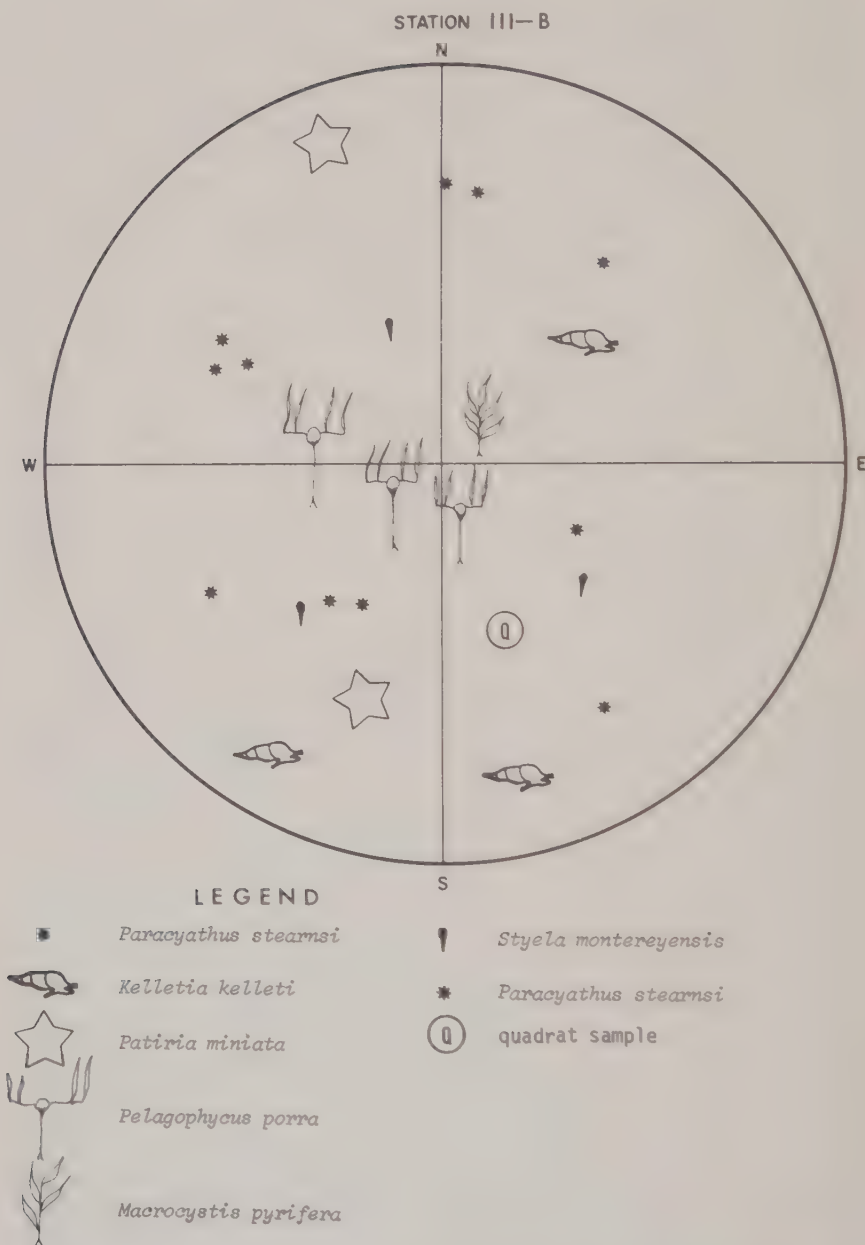
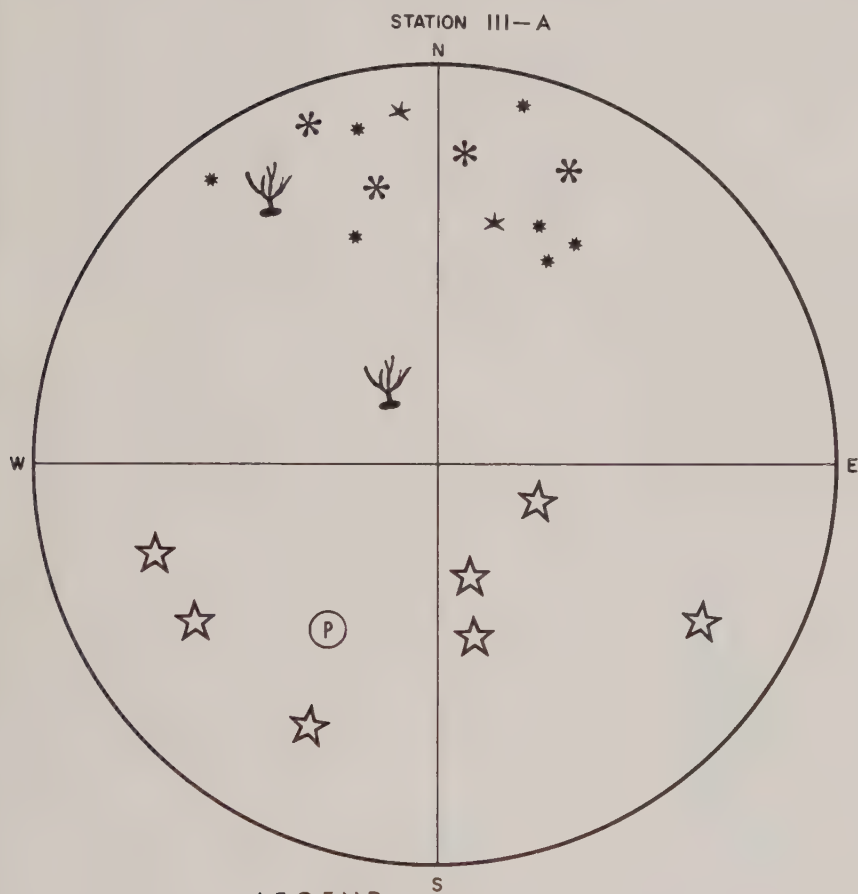


FIGURE 20 A pictorial representation of the arc study area, Station III-B (approximately 15 square meters of bottom area), 80-foot depth, depicting the more obvious biotic features and the sampling locations.



Astropecten vermilli



Lophogorgia chilensis



polychaete sample



Rhodymenia sp.



Henricia leviuscula



Paracyathus stearnsi

FIGURE 21 A pictorial representation of the arc study area, Station III-A (approximately 30 square meters of bottom area), 100-foot depth, depicting the more obvious biotic features and the sampling locations.

TABLE 4
Plants and Animals Recorded from Transect IV, Point Loma, February 16, March 10 and 11, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
ALGAE							
<i>Enteromorpha</i> sp.						P	Seen throughout the intertidal zone
<i>Colpomenia striuosa</i>					(P) [3]	P	Seen throughout the intertidal zone
<i>Cytosocira oemundacea</i>					C, (1)	P	6 to 12 inches high
<i>Dictyota flabellata</i>						P	Seen at the low tidal zone
<i>Egretta laevigata</i>							
<i>Macrocystis pyrifera</i>			P	5 4/m ²			
<i>Pelagophycus porra</i>		1/3m ²	2/m ²	2/m ²			
<i>Pelvetia fastigiata</i>							Both juvenile and adult plants present
<i>Pterygophora californica</i>						P	Seen in the mid-tidal zone
<i>Bosniella orbigniana</i>			[C]	A, (P), [2] S, [S]	A [C]		
<i>Botryocladia</i> sp.		C, [1]					
<i>Calliarthron regenerans</i>							
<i>Corallina officinalis</i>	S	C	C	A C	A, [F]	P	Seen at the low tidal zone
<i>Gelidium nudifrons</i>					[1]	P	A large "clump"
<i>Gelidium purpurascens</i>						P to S	From the low to mid-tidal zone
<i>Gelidium</i> sp.				[S]			Encrusting a rock
<i>Lithothamnium imitans</i>					(C)	P	Seen near the low tidal zone
<i>Lithothamnium</i> sp.							
<i>Plocamium pacificum</i>							
<i>Rhodomyenia pacifica</i>	C, [1]						A small colony
<i>Rhodomyenia palmelliformis</i>			[1]		(C)		Small plants
<i>Rhodomyenia</i> sp.		C, (P)	(P)			P	
coralline unid.	(S)	(C)	(P)	(C)		S	
<i>Rhodophyta</i> unid.		[P]				C to S	A flowering plant
<i>Phyllospadix torreyi</i>							

TABLE 4—Continued
Plants and Animals Recorded from Transect IV, Point Loma, February 16, March 10 and 11, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
<i>Ceratophyllaceae</i>							
<i>Pocillochaetia johnsoni</i>	((1))		(1)				
<i>Pteris inflata</i>	((1))	[1]	(1)				
<i>Glycyrrhiza</i> sp.	((1))			((6))			
<i>Ophiodromus pugilensis</i>	((1))						
hesperionid unid.		[1]	[2]				
<i>Leimbriueridae</i>							
<i>Neeridae</i>		[1]	(P)	(6)			
<i>Diopatra ornata</i>		(S)					
amphid unid.		P					
<i>Phyllodoceidae</i>			((1))				
<i>Polynoidae</i>	((1))	[6]	[4]	((2))			
<i>Subellaria cuneatulum</i>			[2]	((1))			
<i>Chone</i> sp.			[3]				
subellid unid.	((1))	[2]	[1]			C	Seen in the mid-tidal zone
<i>Salmaeina tribranchiata</i>	S				(P)		
<i>Serpula vermicularis</i>							
serpulid unid.				((1))			
<i>Prionospio</i> sp.							
<i>Spiothanes bombyx</i>	((1))						
<i>Syllidae</i>	[2]	[3]	[5]				
<i>Polychaeta</i> unid.	[1]						
<i>Sipunculida</i>							
<i>Deudrotomum pygmaea</i>			[1]			1	In rock, near the low tidal zone
<i>Golfingia</i> sp.		[2]					
sipunculid unid.							
Arthropoda							
Ostracoda	[1]	((5))		((1))			
<i>Balanus concavus pacificus</i>			((1))			P	Seen near the upper tidal zone
<i>Balanus glandula</i>			(P)			P	Seen from the mid-tidal to high tidal zone
<i>Cithamalus farrus</i>							

TABLE 4—Continued
Plants and Animals Recorded from Transect IV, Point Loma, February 16, March 10 and 11, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
<i>Cerastostoma nuttallii</i>				5		P	
<i>Conus californicus</i>		(P)		P			
<i>Crepidula onyx</i>		[14]	[1]	[2]			
<i>Crepidatella lingulata</i>		(1)		P			
<i>Dendrodoris albopunctata</i>	P		[1]				
<i>Dialia acuta</i>				P			
<i>Diatula sandvegensis</i>							
<i>Diodora murina</i>			E	C		P	
<i>Fissurella volcano</i>							
<i>Flabellina iodinea</i>	(P)	P, (1)		1			
<i>Haliotis fulgens</i>							
<i>Haliotis rufescens</i>		2, (1)	1				
<i>Hoplinscia rosacea</i>							
<i>Kelletia kelletii</i>			(P)	100+ (P), [1]		2	Large specimens Seen near the low tidal zone
<i>Littorina planaxis</i>						P	
<i>Marginella californica</i>						1	
<i>Micranellum crebricinctum</i>		[4], ((7))	((15))	[1], ((5))	((1))		
<i>Mitra calatinae</i>				20			
<i>Mitra idae</i>				S			
<i>Mitrella gouldii</i>			[1]	P, [1]	[1]	1	
<i>Odostomia terricola</i>			((1))				
<i>Olivella baetica</i>				1			
<i>Pterynotus trialatus</i>				P		P	
<i>Serpulorbis squamigerus</i>				[2]			
<i>Solaritella varicosa</i>							
<i>Tegula aureotincta</i>				[1]		P	
<i>Tegula funebralis</i>						P	
<i>Tegula</i> sp.....				P, [2]			
<i>Tricolia compla</i>			[2]		[11]		
<i>Tritonia festiva</i>							
<i>Zonaria spadicea</i>	P			S			
<i>Arcuatula demissa</i>							
<i>Chama pellucida</i>		[2]			C, (P)	P, [1]	

Seen near the mid-tidal zone

TABLE 4—Continued
Plants and Animals Recorded from Transect IV, Point Loma, February 16, March 10 and 11, 1965
Station and Abundance *

Scientific Name	A	B	C	D	E	Intertidal	Remarks
Ascidacea							
<i>Trididemnum opacum</i>	(S) [1]			C, [1]	(P)	P	
ascidian unid.....			1 (5)				36 inches long 10 to 20 inches long 18 inches long 4 to 10 inches long 5 to 10 inches long 12 to 36 inches long 6 to 9 inches long 2 to 5 inches long 5 to 7 inches long 8 to 12 inches long 10 to 18 inches long 6 to 7 inches long
VERTEBRATA							
<i>Myxobolus californicus</i>	20	30					
<i>Paralabrax clathratus</i>	1						
<i>Paralabrax nebulifer</i>	75						
<i>Embiotoca jacksoni</i>	300	200					
<i>Chromis punctipinnata</i>	30	50	300+ (25)				
<i>Pseudomelotopon pulchrum</i>	70	100	14, (8)	75			
<i>Ozujukia californica</i>	50, [1]	A, (1)	C, (C)				
<i>Coryphopterus nicholsi</i>	15						
<i>Sebastodes dalii</i>	25	15					
<i>Sebastodes miniatus</i>	20	15					
<i>Sebastodes serranoides</i>	15						
<i>Ozylebrius pictus</i>							
<i>Clinocottus analis</i>							
<i>Neoclinus uninotatus</i>			1				
<i>Rathbunella hypoplecta</i>		10	1			P	9 inches long 6 to 7 inches long
<i>Rathbunella</i> sp.	1						

* Abundance symbols:

P = Present in the area but relative abundance not estimated.

B = Sparse—widely scattered throughout the area but nowhere numerous.

C = Common—uniformly present throughout the area and only occasionally numerous.

A = Abundant—numerous and evenly distributed throughout the area.

[1] = Brackets around the abundance symbol indicate occurrence within the quadrat; 0.25 m on a side.

() = Parentheses around the abundance symbol indicate occurrence within the are study area.

(()) = Double parentheses around the abundance symbol indicate occurrence in the polychaete sample.

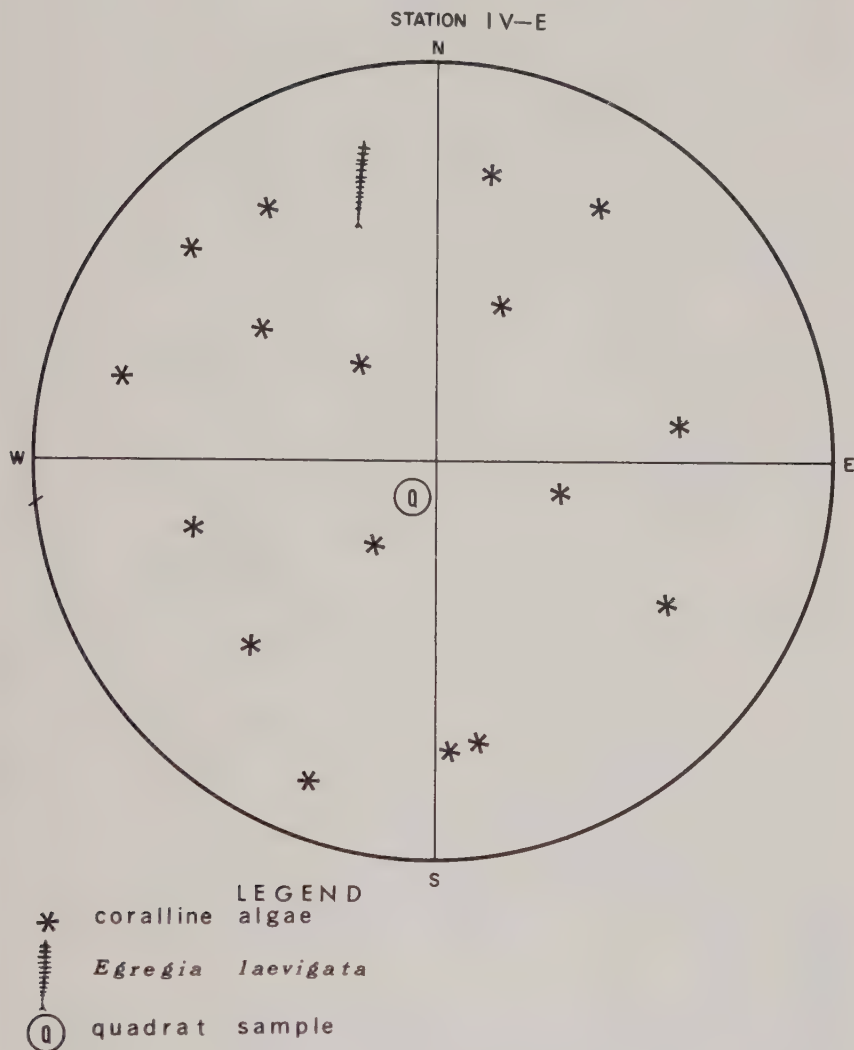


FIGURE 22 A pictorial representation of the arc study area, Station IV-E (approximately 15 square meters of bottom area), 20-foot depth, depicting the more obvious biotic features and the sampling locations.

Forty-foot depths (Station IV-D) were reached about 500 yards offshore. Here the bottom was characterized by low mudstone shelves, 8 to 10 inches high, topped with numerous cobbles and medium-sized boulders. A dense bed of giant kelp formed an extensive canopy, shading the lower growing algae. *Pterygophora* remained abundant but strap kelp was quite sparse, approaching its bathymetric limit. Significant increases in the invertebrate populations were readily apparent (Table 4). Red and purple sea urchins, inveterate kelp grazers, were common, but confined themselves to crevices and beneath the

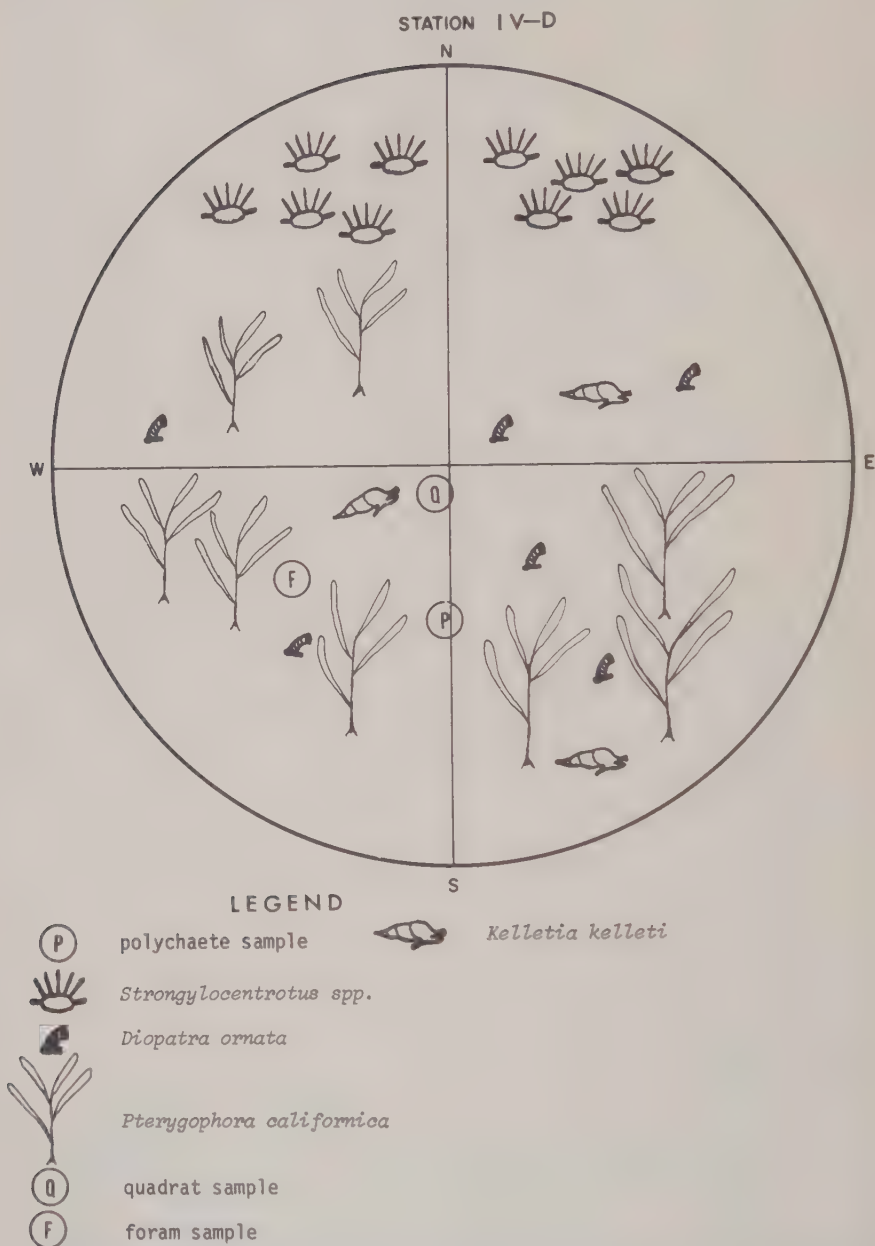


FIGURE 23 A pictorial representation of the arc study area, Station IV-D approximately 15 square meters of bottom area), 40-foot depth, depicting the more obvious biotic features and the sampling locations.

ledges. Of the abundant mollusks, the whelk *Kelleteria kelleteria* was dominant. Fishes were lacking; only señoritas were recorded. The arc study area diagram (Figure 23) is especially representative of this station's general biota.

In the 60-foot depths (Station IV-C), about 1,500 yards offshore, low shelves, exposed large boulders, and numerous, shallow, sand-filled rifts characterize the bottom. Giant kelp and elk kelp produce an extensive canopy. Solitary stony corals were common on the rocks, with the tube worm *Diopatra ornata* prevalent in the numerous sand-filled areas. Sea stars, particularly the bat star *Patiria miniata*, were well-represented. Kelp was absent from the arc study area (Figure 24). An increase in the fish fauna was readily apparent (Table 4).

The 80-foot depths (Station IV-B) were also characterized by pavement-like substrate, criss-crossed with narrow, sand-filled rifts and scattered cobbles and medium-sized boulders. Proximal to the quantitative study area were low (8 to 10 inches high) ledges, and 70 feet away, 2- to 3-foot high rocky outcrops were distinctive.

Elk kelp, extending to within 20 feet of the surface, dominated the macroscopic biota but again was absent from the quantitative arc study area (Figure 25). Low-growing red algae comprised the remainder of the algal community. Stony corals and sea stars were common, and 20 red sea urchins were recorded in the general station area. The gorgonian *Lophogorgia chilensis*, a normal inhabitant of these depths, was also observed. Numerous polychaete worms, crustaceans, and mollusks, not seen in the general survey, were recorded in our quadrat sample (Table 4).

Of the eight fish species recorded at this station, California sheephead (*Pimelometopon pulchrum*), attaining estimated lengths of 36 inches, were the most obvious. Bluespot gobies (*Coryphopterus nicholsi*) were more abundant, but due to their cryptic habits and small size, were less apparent.

The shelf edge, reached at the 100-foot depths (Station IV-A), was pavement-like sandstone, with large boulders, low shelves, and pockets of sand and shelly debris (Figure 26). No large kelps or algae occurred, although low-growing red algae were common (Table 4). Solitary stony corals (*Paracyathus stearnsi*) were especially abundant, with two species of gorgonians particularly obvious (Figure 27). Again, a variety of sea stars was observed. Twelve species of fishes were recorded, including three rockfish, all common to these depths along the rocky southern California coastline.

Extralimital Sampling

Three offshore stations (designated G-1, G-2, and G-3 on Figure 1) were occupied in addition to the transect diving stations. One sample was collected at each (with a small Hayward orange-peel grab) to note the presence or absence of sludge. No sludge was observed in these samples, but hydrogen sulfide (H_2S) odors were common to two (G-1 and G-2). Concurrent and subsequent corings taken by the San Diego Regional Water Quality Control Board staff revealed varying depth layers of sludge (Leonard Burtman, pers. comm.).

Station G-1 was contiguous with Transect III in 220-foot depths. Its sample consisted of 3 to 4 quarts of soft, silty mud with a slight H_2S odor. Many dead gastropod and scaphopod shells were noted.

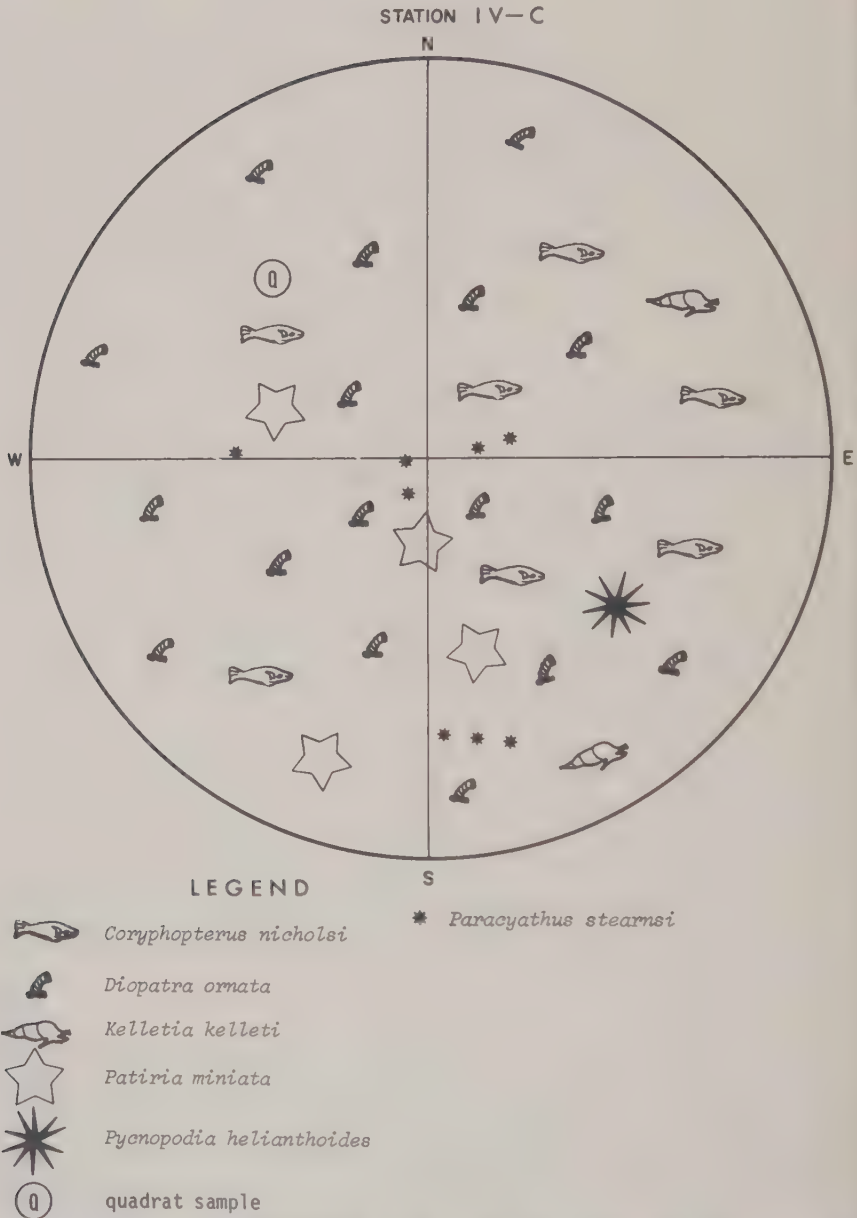


FIGURE 24 A pictorial representation of the arc study area, Station IV-C (approximately 15 square meters of bottom area), 60-foot depth, depicting the more obvious biotic features and the sampling locations.

STATION IV-B

N



LEGEND

- | | | | |
|-----|-------------------------------|-----|------------------------|
| (P) | polychaete sample | (Q) | quadrat sample |
| | <i>Coryphopterus nicholei</i> | (F) | foram sample |
| | <i>Diopatra ornata</i> | | <i>Patiria miniata</i> |
| | <i>Henricia leviuscula</i> | | |
| | <i>Haliotis rufescens</i> | | |
| | <i>Corynactis californica</i> | | |
| | coralline algae | | |
| | <i>Paracyathus stearnsi</i> | | |

FIGURE 25 A pictorial representation of the arc study area, Station IV-B (approximately 30 square meters of bottom area), 80-foot depth, depicting the more obvious biotic features and the sampling locations.

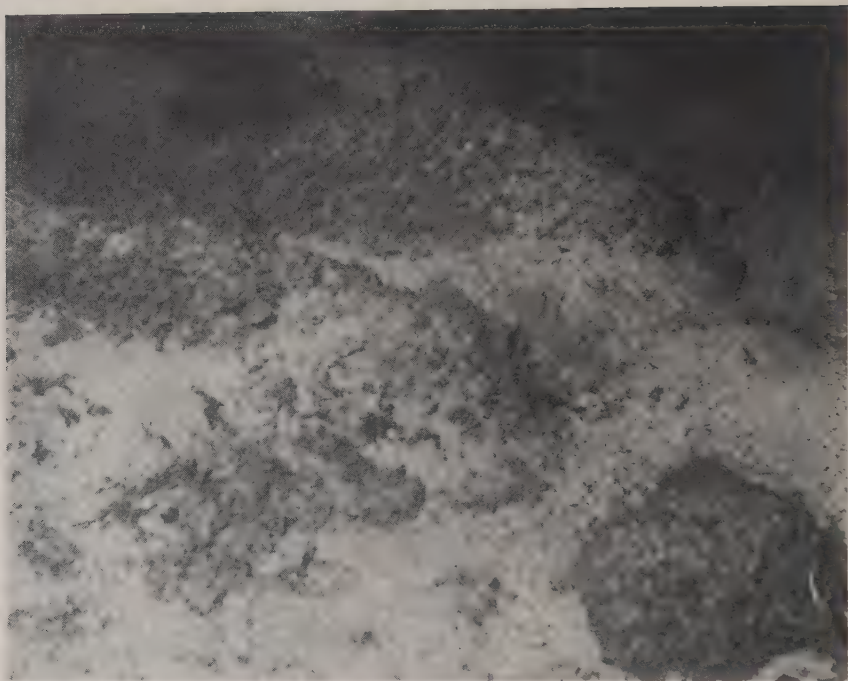


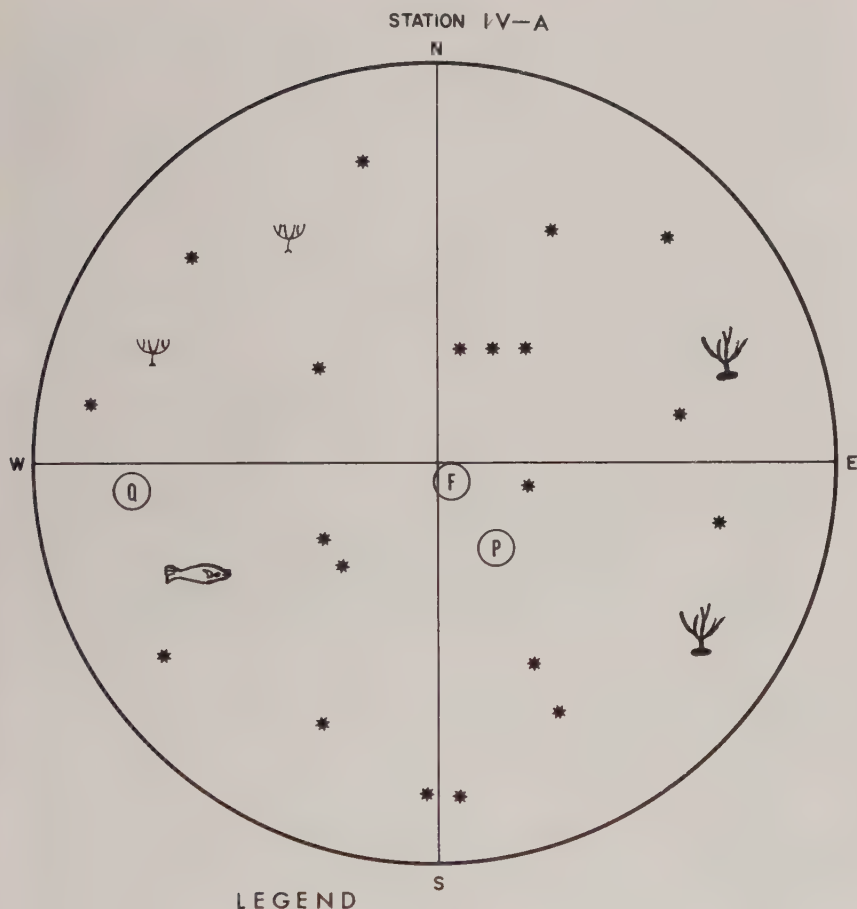
FIGURE 26 Pockets of sand and shell cover portions of the pavement rock at the terrace edge, Station IV-A (100-foot depths). Photo by Charles H. Turner.

Station G-2 was in the center of the outfall's "Y"-shaped terminus in 220-foot depths. Six quarts of fine, dark, silty mud with a slight H_2S odor were collected and screened.

Station G-3 was contiguous with Transect IV in the 220-foot depths. Three quarts of dark silty mud, without an H_2S odor, were collected and screened.

We identified the animals in each sample and sent the polychaete worms, foraminiferans, and gammarid amphipods to specialists. Only the polychaete identifications are included in this report (Table 5).

This offshore area, between 20 and 50 fathoms deep, has been characterized by Barnard and Ziesenheim (1961) as typically harboring an *Amphiodia urtica* community. Therefore, it was not unexpected to find this ophiuroid dominant in our samples. Of particular significance, however, is the occurrence of *Capitella capitata* in the sample nearest the outfall. This "Pollution-tolerant" polychaete previously had not been recorded in this immediate area, and its presence is indicative of an adverse environmental change, according to Donald J. Reish (pers. comm.). Defining the areal distribution of *Capitella capitata* will help delimit the present area influenced by the outfall.



Lophogorgia chilensis



Eugorgia rubens



Coryphopterus nicholsi



quadrat sample



polychaete sample



foram sample



Paracyathus stearnsi

FIGURE 27 A pictorial representation of the arc study area, Station IV-A (approximately 15 square meters of bottom area), 100-foot depths, depicting the more obvious biotic features and the sampling locations.

TABLE 5
Animals Recorded from the Orange-Peel Grab Samples Taken Offshore from Point Loma, March 9, 1965

Species	G-1	G-2	G-3	Species	G-1	G-2	G-3
Platyhelminthes.....	2			<i>Pilargis hamatus</i>	1	1	
Nematoda.....		P*	P	platygid unid.....		1	
Annelida.....				Polynoidae.....	7	16	P
<i>Capitella capitata</i>		2		<i>Laonice cirrata</i>		1	
<i>Capitella ambiseta</i>	P	1	1	<i>Prionospio pinnata</i>	1		1
<i>Cossura candida</i>	1		1	<i>Prionospio pygmaeus</i>	4		1
<i>Tharyx parvus</i>	3			<i>Prionospio</i> sp.....		5	
cirratulid unid.....		1		<i>Spiophanes missionensis</i>	1	2	
flabelligerid unid.....		1		spionid unid.....		3	
<i>Glycera</i> sp.....	2	3	P	<i>Sternaspis fossor</i>	1	1	1
<i>Goniada littorea</i>	1		P	Terebellidae.....		4	
<i>Ophiadromus pugelensis</i>	1	1	P	<i>Terebellides stroemi</i>	1		
<i>Lumbrineris</i> sp.....	7	4	P	Echiuroidea.....			
<i>Magelona pacifica</i>			P	<i>Listriolobus pelodes</i>	2		
<i>Magelona</i> sp.....	1		P	Arthropoda.....			
<i>Aziothella</i> sp.....	1			Ostracoda.....	P	P	P
<i>Praxillella affinis pacifica</i>		1		Cumacea.....	P		
<i>Praxillella</i> sp.....	1			Tanaidacea.....	1		
malacand unid.....	1	3	P	Gammaridea.....	P	P	P
<i>Nephtys</i> sp.....	8	19	P	Caprellidea.....	P		
<i>Nereis procera</i>	1			Mollusca.....			
<i>Armandia bioculata</i>		1	P	Aplacophora.....			2
<i>Travestia brevis</i>	2			<i>Cylichna alba</i>	4	5	5
<i>Haploscoloplos elongatus</i>	2	2		<i>Ophiidermella incisa</i>			1
<i>Paraonis</i> sp.....	8	10		<i>Volutebella cylindrica</i>	2	5	3
paranoid unid.....		1	P	<i>Tellina</i> sp.....			2
<i>Pectinaria californiensis</i>	4			Echinodermata.....			
<i>Eteone</i> sp.....		1	P	<i>Amphiodia urtica</i>	86	133	69
phyllocid unid.....	1	2					

* P = Present in the sample but relative abundance not estimated.

DISCUSSION

Oceanographic studies along the westerly shore of Point Loma were conducted by San Diego Marine Consultants (1959, 1962) prior to the construction and operation of the submarine outfall. These surveys evaluated the marine environment, giving background information which, when compared with subsequent surveys, might indicate changes attributable to operation of the outfall; outfall operation commenced late in 1963.

Six of our stations (two intertidal and four nearshore) approximated those surveyed by San Diego Marine Consultants in 1961. We have attempted pre- and post-operative comparisons with these stations despite the fact that: (i) considerable variation exists between sampling techniques of this and the previous study; and (ii) emphasis on pertinent environmental features varied considerably between the studies. In general the biotic conditions observed (1961 and 1965 survey) appear similar and no adverse changes, directly attributable to outfall operations, were noted.

The intertidal stations selected for comparative purposes, Transects I and IV, correspond to Stations G and E respectively of San Diego Marine Consultants (1962). Intertidal-I was largely characterized in our studies by its algal distributions and associated littorine snails; it had only a fraction of the speciation reported in 1962. The 1965 paucity of species appears to be the result of severe wave action and continual erosion and sanding-in of the ledges, rather than outfall operation.

Intertidal-IV exhibited excellent species diversity during both studies, with the exception that top-snails (*Astraea undosa*) and chitons (*Ischnochiton* sp.), prevalent in 1961, were not recorded by us, and the fishes reported as "teeming" in the upper tide pools during 1961 were not seen during our study. The algal diversity existing in 1965 approximated that recorded in 1961.

The four nearshore diving stations we selected for comparison, and their 1961 counterparts (in parentheses) were: I-C (K-7), III-D (K-4), IV-D (K-3), and IV-A (L-6).

Station I-C was described as an extremely lush area in 1961; coral-line and brown algae dominated, and animal forms were abundant. Occasional giant kelp plants were noted, and many dead hold-fasts were seen. In 1965, we found a moderate bed of giant kelp apparently somewhat more extensive than that which existed in 1961. Sea urchins were present (as in 1961) but were largely restricted to crevices and beneath boulders. Contrasting with this areal increase in the giant kelp, we noted a decrease in the lower-growing brown algae—a normal sequence in plant succession within a bed of giant kelp. In general, there was favorable agreement between species recorded in the 1961 and 1965 surveys. Differences, in most instances, were attributable to survey techniques.

Station III-D exhibited gross biotic changes between 1961 and 1965, not an unexpected occurrence since its location corresponds closely to the outfall pipe—a non-existent structure in 1961. Significantly the changes (apparently brought about by substrate improvement) have been favorable. Giant kelp, absent in 1961, formed a moderate

to heavy bed throughout the general station area. Purple sea urchins, the dominant biotic form in 1961, were not seen by us. Twenty-one animal and two plant species were noted in 1961, about half the diversity we observed in 1965 (46 animal and 3 plant species).

Although Station IV-D had similar invertebrate speciation in both 1961 and 1965, with boring clams, purple and red sea urchins, and bat stars dominating, distinct changes in the algal community were noted. Coralline algae, recorded as the dominant plants in 1961 were still abundant in 1965, but the dominant species was giant kelp, which formed a dense bed with an expansive canopy. In addition, elk kelp, strap kelp, and a low-growing brown alga, *Pterygophora californica*, which were sparse to abundant in our general station area, were not recorded in 1961.

Station IV-A, located in the 100-foot depths, roughly approximated station L-6 (92 feet deep) of San Diego Marine Consultants (1962). Here we recorded the coralline alga *Corallina officinalis* (dominant in 1961) as sparse. A juvenile giant kelp plant found at Station L-6 in 1961 (a depth considered marginal for giant kelp in this area) is notable. We did not find giant kelp beyond Station IV-C (60-foot depth) along this transect. Solitary corals proved to be the dominant sessile animals in both 1961 and 1965, and estimates of their abundance were identical. Three plant and 16 animal species were recorded in 1961, considerably fewer than the 3 plant and 49 animal species we recorded in 1965. This greater diversity in 1965 appears to reflect differences in sampling techniques. Only three fish species were recorded in 1961; we observed 12.

An initial recognizable feature of unfavorable environmental conditions is the lack of biotic diversity. As environmental conditions become harsh, mobile animal forms, finding conditions untenable, emigrate; attached plants and animals, intolerant to the situation, succumb. Those remaining are tolerant forms which, due to reduced competition, exhibit high abundance levels. This sequence of events has been observed, not infrequently, along the southern California coastline.

Tolerant sessile forms of the open coast are usually eurybathic (tolerating wide depth distributions), eurythermic (tolerating wide temperature ranges), and euryhaline (tolerating wide salinity ranges).

Disregarding all other environmental factors, we grouped those plants and animals recorded at five consecutive depth-stations (i.e. intertidal to 80-foot, or 20-foot to 100-foot depths). Interestingly, most of the species usually associated with impoverished biotic conditions (on rocky substrates) appear in this list (Table 6). Increases in their abundance levels, relative to associated species, probably would be indicative of an unfavorable environment such as would be caused by sewage discharge. Of the five algae listed, two articulated corallines *Bossiella* and *Corallina* were found from the intertidal to depths exceeding 100 feet. These two have also been noted as abundant off the Palos Verdes Peninsula (near Los Angeles), an area influenced by an outfall discharge. The other three algae may also be tolerant forms indicative of restrictive environmental situations.

TABLE 6

Plants and Animals Observed at Five or More Consecutive Depth-stations
Offshore from Point Loma, February and March, 1965

ORGANISM	DEPTH, FEET										
	0	10	20	30	40	50	60	70	80	90	100
ALGAE											
<i>Cystoseira osmundacea</i> -----	x	x	x	x	x	x	x	x x			
<i>Dictyopteris zonarioides</i> -----	x	x	x	x	x	x	x	x x			
<i>Bossia orbigniana</i> -----	x	x	x	x	x	x	x	x	x	x	x
<i>Corallina officinalis</i> -----	x	x	x	x	x	x	x	x	x	x	x
<i>Placodium pacificum</i> -----	x	x	x	x	x	x	x	x	x	x	
INVERTEBRATES											
Protozoa											
<i>Gromia oviformis</i> -----	x	x	x	x	x	x	x	x	x	x	x
Porifera											
<i>Azinella mexicana</i> -----	x	x	x	x	x	x	x	x	x	x	x
<i>Craniella arb</i> -----			x	x	x	x	x	x	x	x	x
Mollusca											
<i>Crepidatella lingulata</i> -----	x	x	x	x	x	x	x	x			
<i>Megathura crenulata</i> -----	x	x	x	x	x	x	x	x			
<i>Micranellum crebricinctum</i> -----	x	x	x	x	x	x	x	x	x	x	x
<i>Mitrella gouldii</i> -----	x	x	x	x	x	x	x	x			
<i>Tricolia compla</i> -----	x	x	x	x	x	x	x	x			
<i>Hiatella arctica</i> -----	x	x	x	x	x	x	x	x			
Brachiopoda											
<i>Terebratalia transversa</i> -----	x	x	x	x	x	x	x	x	x	x	
Echinodermata											
<i>Amphipholis pugetana</i> -----	x	x	x	x	x	x	x	x			
<i>Ophiothrix spiculata</i> -----			x	x	x	x	x	x	x	x	
<i>Patiria miniata</i> -----	x	x	x	x	x	x	x	x	x	x	x
<i>Strongylocentrotus</i> spp.-----	x	x	x	x	x	x	x	x			

Of the 14 invertebrate species exhibiting this wide bathymetric distribution, sea urchins (*Strongylocentrotus* spp.), brittle stars (*Amphipholis pugetana* and *Ophiothrix spiculata*), bat stars (*Patiria miniata*), and three mollusks (*Crepidatella lingulata*, *Megathura crenulata*, and *Hiatella arctica*), are known to flourish in harsh environments. Less is known about the environmental requirements of the others, but we suggest that they too are hardy, tolerant forms that should be closely monitored in future surveys.

SUMMARY

The subtidal area (into 100-foot depths) west of Point Loma, San Diego County, was visually surveyed by biologist-divers to ascertain the number and diversity of marine life. These data were compiled for, and will be used by, the San Diego Regional Water Quality Control Board in its evaluation of environmental changes (if any) which have occurred due to operation of an ocean outfall in this area.

Field work was conducted during February and March 1965. During this period, 20 diving stations and 4 intertidal areas were occupied along four transects, lying perpendicular to shore from the intertidal into 100-foot depths.

We employed a modified transect-quadrat method of survey, quantitatively and qualitatively sampling the animals and plants present.

General observations, including core samples of the substrate in sand bottom areas, were made at each station. Quantitative sampling, by actual removal of all organisms within a quadrat 0.25 m on a side, were identified and recorded.

In addition, three orange-peel grab samples were taken in the 220-foot depths around the outfall terminus, primarily to determine sludge build-up. No sludge build-up was observed in these samples but analysis of the animals present indicated an adverse change in the environment near the outfall terminus. Concurrent and subsequent corings by the Regional Board's staff have shown a build-up of sludge.

Only two of the diving stations were sufficiently sandy for cores to be taken: Station II-A was uniform fine gray sand; Station II-E, coarse red sand (Appendix 1).

Water visibility (clarity) was generally poor at the inshore stations, becoming more favorable at intermediate and offshore locations. Water clarity at the sample areas ranged from less than 1 foot (Station I-E) to an estimated 25 to 30 feet at Station II-D (Appendix 1).

Bottom temperatures at the sample areas ranged from 54.1°F at Station III-A (100-foot depth) to 56.3°F at Station III-D (40-foot depth) (Appendix 1). Twenty-four-hour thermograph recordings, taken at Stations III-A and IV-B, indicated uniform diurnal-nocturnal fluctuations, of about 1°F; maximum temperatures occurred nocturnally (Figure 3). At all stations, temperature and visibility generally decreased with depth (Figures 4, 5).

Giant kelp was sparse in the northern survey areas (Transect I), did not occur in the central sector (Transect II), and was sparse to heavy in the south (Transects III and IV). Bathymetrically it ranged from 20- through 75-foot depths.

Elk kelp was common at the deeper stations, and strap kelp persisted in the shallows (less than 20-foot depths). Several low-growing browns were common to abundant in the 20- and 40-foot depths.

The animal life was varied and lush with sponges, solitary stony corals, whelks, limpets, boring pholads, nudibranchs, bat stars, brittle stars, sea urchins, solitary and colonial tunicates, sea cucumbers, and a wide variety of bryozoans dominating. In general, the recorded species, numbers, and diversities were typical for this geographic area, water depth, and bottom type.

Bathymetrically the most diverse speciation occurred in the 60- to 80-foot depths, while the least was in 20. Central Point Loma (Transect II) had the most varied biota, closely followed by the southern area (Transects III and IV). To the north, Transect I, due to its extremely low relief, exhibited the least diversity.

Six of our stations approximated those surveyed by San Diego Marine Consultants in 1961. Although direct comparisons were difficult, because of differences in sampling techniques, significant increases in giant kelp were apparent at three of the stations. In general, the biotic conditions observed along this submerged terrace (1961 and 1965 surveys) appeared similar and no adverse changes, directly attributable to outfall operations, were apparent in 1965. Five plants and 14 animals are mentioned as particularly hardy; these should be closely monitored in future surveys to detect changes in their abundance levels relative to associated species.

Because the outfall was operative only 18 months when our survey was conducted, insufficient time may have elapsed for the more subtle changes to have become apparent in the rocky areas. Therefore, we recommend continued surveillance of this area, along the lines of the 1965 study, at least annually for the next several years. During this period, any biotic changes, relative to the outfall operations, should become apparent.

Offshore, near the outfall terminus, the presence of *Capitella capitata* (a hardy polychaete worm) indicates an adverse environmental change attributable to the outfall. Further study of this area, beyond the scope of our investigation, is definitely warranted.

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APPENDIX 1
Physical Data for 24 Stations Occupied During a Survey of the Marine Environment Offshore from Point Loma
February-March 1965

Station	Date	Depth (feet)	Bottom temp. °F	Diver estimated bottom visibility (feet)	Characteristic features and remarks
TRANSECT I Intertidal-----	2-17-65	--	--	--	Transect 90 feet long extending across deeply incised sandstone shelves from low water (-1.2-foot tide) to the cliff base. Quadrat sample taken at midpoint of transect (45 feet).
E-----	2-15-65	17	--	0.5	<i>General area:</i> Low mudstone shelves; heavily bored. <i>Remarks:</i> Strong surge and reduced visibility impaired the survey.
D-----	2-15-65	40	55.9	2-4	<i>General area:</i> Low mudstone shelves; heavily bored. <i>Arc area:</i> Incised with shallow surge channels which were filled with extensive shelly debris.
C-----	2-15-65	54	55.8	12-15	<i>General area:</i> Rocky; large crevices. <i>Arc area:</i> Rocky; shelves to 12 inches high, interspersed by gullies. Heavy sediment accumulation on the shelves and in the gullies.
B-----	2-15-65	80	55.2	15	<i>General area:</i> Low rocky shelves; scattered boulders. <i>Arc area:</i> Rocky; low relief.
A-----	2-15-65	94	55.2	15-20	<i>General area:</i> Pavement-like rock; large rock shelves recorded 60 feet from arc area at (240° magnetic). A marked increase in the bottom slope was noted. One hundred feet from the arc area (at 240°) the depth was 105 feet.
TRANSECT II Intertidal-----	2-16-65	--	--	--	Transect 190 feet long extending across deeply incised (to 3 feet) sandstone shelves from the low tidal to the cliff base. Numerous small tide pools were observed. The quadrat sample was removed at the transect midpoint (95 feet).
E-----	2-17-65	18	--	15-17	<i>General area:</i> Low sandstone shelves 4 to 12 inches high. <i>Arc area:</i> Low sandstone shelves 6 to 8 inches high, with scattered cobbles on top. <i>Remarks:</i> Strong surge; much detrital matter in suspension.

D-----	2-17-65	40	55.6	25-30	<i>General area:</i> Large boulders to 2 feet high scattered about on the heavily bored pavement-like sandstone. <i>Arc area:</i> Pavement-like sandstone base, heavily bored; on top of this were two large boulders and a small ledge 8 to 10 inches high.
C-----	2-17-65	60	55.5	20	<i>General area:</i> Pavement-like sandstone covered in parts with coarse sand, and boulders and rocky outcrops. One rocky outcrop 8 feet high only 40 feet east of the arc area. <i>Arc area:</i> Pavement-like sandstone with an overlay of coarse sand.
B-----	2-17-65	80	55.4	20	<i>General area:</i> Rocky pinnacles 8 to 10 feet high, surrounded by low rock rubble and coarse sand. Sandy areas moderately extensive 10 to 12 feet across and 3 to 4 inches in thickness. <i>Arc area:</i> Rock ledge 8 to 14 inches high on the pavement sandstone; partially covered by intruded coarse sand.
A-----	2-18-65	100	55.0	12-15	<i>General area:</i> Extensive sandy areas interspaced between large (to 15 feet high) rocky outcrops. One, 8 feet high, was located 40 feet east of the arc area. <i>Arc area:</i> Sand; core 8 inches long consisting of uniform medium gray sand. Ripple marks 1 to 2 inches high; 10 to 12 inches between their crests, aligned in a north-south direction (parallel to shore).
TRANSECT III					
Intertidal-----	2-16-65	--	--	--	Transect 35 feet long extending across the narrow sandstone shelf from low water to the base of the cliff. The quadrat sample was removed 11 feet from low water.
E-----	3- 8-65	20	--	1-3	<i>General area:</i> Coarse red sand. Core 9 inches long; uniform coarse red sand and shelly debris. Ripple marks 3 to 4 inches high; 6 to 8 inches between their crests, aligned parallel to shore. <i>Remarks:</i> Strong surge and reduced visibilities impaired the survey.
D-----	3- 8-65	40	56.3	3-5	<i>General area:</i> Pavement-like sandstone substrate cut by numerous 1- to 2-inch deep rifts, extensively bored. Several large boulders seen; possibly rip-rap from the outfall pipe coverings. The outfall pipe and rip-rap was not seen. <i>Remarks:</i> A strong surge was encountered impairing the survey.
C-----	3- 8-65	55	54.5	12-15	<i>General area:</i> Pavement-like rock, with scattered boulders and low rock ledges. <i>Arc area:</i> Low, flat, heavily bored, light colored sandstone; easily broken in handling. Numerous pits and depressions filled with sand.
B-----	3- 9-65	75	55.5	15-20	<i>General area:</i> Rocky outcrops 3 to 4 feet high interspersed on the pavement-like sandstone. Some cobbles and boulders. <i>Arc area:</i> Low, flat sandstone; deeply pocked. Just seaward of the arc area was the edge of this flat shelf. The shelf's sheer face dropped 20 feet onto a fine gray sand and boulder strewn bottom.
A-----	3- 8-65	105	54.1	15-20	<i>General area:</i> Extensive sandy areas interspersed with large, rocky outcrops, to 20 feet high. <i>Arc area:</i> On sand and rock; rock projecting 3 feet above the sand. <i>Remarks:</i> This station represents the seaward juncture of the rocky and sandy substrates along Transect III.

APPENDIX 1—Continued
Physical Data for 24 Stations Occupied During a Survey of the Marine Environment Offshore from Point Loma
February–March 1965

Station	Date	Depth (feet)	Bottom temp. °F	Diver estimated bottom visibility (feet)	Characteristic features and remarks
TRANSECT IV Intertidal-----	2-16-65	--	--	--	Transect 306 feet long extending across the extensive flat sandstone shelves from low water to the base of the cliffs. A quadrat sample was removed 150 feet from low water.
E-----	3-10-65	20	56.1	8-10	<i>General area:</i> Pavement-like sandstone; heavily bored; coarse sand filling in the shallow rifts with shelly debris, cobbles, and medium to large boulders also being present. <i>Arc area:</i> An area of boulders each about one-half covered by the coarse red sand. <i>Remarks:</i> A strong surge was present indicating that these boulders undergo extensive covering and uncovering.
D-----	3-10-65	40	55.4	8-10	<i>General area:</i> Pavement-like sandstone with 8- to 10-inch high shelves; extensively bored. Cobbles and boulders present. <i>Arc area:</i> Low cobble shelf; heavily pocked and bored. <i>Remarks:</i> A moderate surge was encountered.
C-----	3-11-65	60	55.2	20	<i>General area:</i> Coarse sand, cobbles and boulders on a pavement-like sandstone base. <i>Arc area:</i> Typical of the general area.
B-----	3-10-65	80	55.0	15-20	<i>General area:</i> Pavement-like sandstone; some cobbles and boulders. <i>Arc area:</i> Many cobbles, a few boulders, coarse sand and shelly debris on top of the yellowish sandstone base.
A-----	3-11-65	105	56.1	8-10	<i>General area:</i> Pavement-like sandstone; overlain by coarse sand and shelly debris, several scattered boulders were noted. This station was near the seaward edge of the submerged terrace. <i>Arc area:</i> Several exposed boulders on the sandstone base; areas of coarse sand between the boulders. <i>Remarks:</i> Only a slight surge was encountered, but due to inclement weather (rain) light penetration was reduced and the bottom was poorly illuminated, impairing the survey.

APPENDIX 2

**Scientific and Common Names of the Plants and Animals
Observed Offshore from Point Loma
February and March, 1965**

Scientific Name	Common Name	Scientific Name	Common Name
ALGAE		INVERTEBRATES AND ASCIDIANS	
<i>Amplisiphonia pacifica</i> Hollenberg	red alga	<i>Acanthina spirata</i> (Blainville)	muricid snail
<i>Anisocladella pacifica</i> Kylin	red alga	<i>Acanthus erithacus</i> de Laubenfels	sponge
<i>Bossiella orbigniana</i> (Decaisne) Silva	coralline alga	<i>Acmaea asmi</i> (Middendorf)	limpet
<i>Botryocladia</i> sp.	red alga	<i>Acmaea fenestrata</i> (Reeve)	limpet
<i>Calliarthron regenerans</i> Manza	coralline alga	<i>Acmaea scabra</i> (Gould)	limpet
<i>Callophyllis marginifruca</i> Setchell and Swezey	red alga	<i>Acmaea paleacea</i> Gould	limpet
<i>Chondria californica</i> (Collins) Kylin	red alga	<i>Acmaea triangularis</i> (Carpenter)	limpet
<i>Codium setchelli</i> Gardner	green alga	<i>Acmaea</i> sp.	limpet
<i>Colpomenia sinuosa</i> (Roth) Derbés and Solier	brown alga	<i>Acteocina cucullata</i> Gould	snail
<i>Corallina gracilis</i> Lamouroux	coralline alga	<i>Acteon punctocostata</i> (Carpenter)	barrel snail
<i>Corallina officinalis</i> Linnaeus	coralline alga	<i>Adocia</i> sp.	sponge
<i>Corallina</i> unid.	coralline algae	<i>Aegires albopunctatus</i> MacFarland	dorid nudibranch
<i>Cryptopleura crispata</i> Kylin	red alga	<i>Agathotoma densilineata</i> Dall	turrid snail
<i>Cystoseira osmundacea</i> (Menzies) C. Agardh	brown alga	<i>Aglaophenia diegensis</i> Torrey	hydroid
<i>Dictyopectis zomarioides</i> Farlow	brown alga	<i>Aglaophenia inconspicua</i> Torrey	hydroid
<i>Dictyota flabellata</i> (Collins) Setchell and Gardner	brown alga	<i>Aglaophenia lophocarpa</i> Allman	hydroid
<i>Drovetia peltata</i> Dawson	red alga	<i>Aglaophenia</i> sp.	hydroid
<i>Egregia laevigata</i> Setchell	feather boa	<i>Alabina tenuisculpta</i> Carpenter	cerithiid snail
<i>Eisenia arborea</i> Areschoug	southern sea palm	<i>Alvania acutirata</i> Carpenter	snail
<i>Enteromorpha</i> sp.	green alga	<i>Amaroucium californicum</i> Ritter and Forsyth	compound ascidian
<i>Gelidium cartilagineum</i> Gardner	red alga	Ampharetidae	polychaete worm (family)
<i>Gelidium nudifrons</i> Gardner	red alga	Amphineura unid.	chitons (class)
<i>Gelidium purpurascens</i> Gardner	red alga	Amphinomidae	polychaete worm (family)
<i>Gelidium</i> sp.	red alga	<i>Amphiodia urtica</i> (Lyman)	brittle star
<i>Gigartina canaliculata</i> Harvey	red alga	<i>Amphipholis pugetana</i> (Lyman)	brittle star
<i>Gigartina serrata</i> Gardner	red alga	<i>Amphisa versicolor</i> Dall	snail
<i>Gigartina volans</i> (C. Agardh) J. Agardh	red alga	<i>Amphiura diastata</i> McClendon	brittle star
<i>Gigartina</i> sp.	red alga	<i>Anachis penicillata</i> Carpenter	snail
<i>Laminaria farlowii</i> Setchell	ribbon kelp	<i>Anisodoris nobilis</i> (MacFarland)	dorid nudibranch
<i>Laurencia diegoensis</i> Dawson	red alga	<i>Anthopleura elegantissima</i> (Brandt)	aggregate anemone
<i>Leptocladia binghamiae</i> J. Agardh	red alga	<i>Anthopleura zanthogrammica</i> (Brandt)	solitary anemone
<i>Lithophyllum imitans</i> Foelie	coralline alga	Anthuridae	isopod (family)
<i>Lithothamnium</i> sp.	coralline alga	Aplacophora	mollusk (order)
<i>Macrocyctis pyrifera</i> (Linnaeus) C. Agardh	giant kelp	<i>Aplysia californica</i> Cooper	sea hare
<i>Microcladia</i> sp.	red alga	<i>Arcuatula demissa</i> (Dillwyn)	horse mussel
<i>Pelagophycus porra</i> (Leman) Setchell	red alga	Arcturidae	isopod (family)
<i>Peiselia fastigiata</i> (J. Agardh) G. De Toni	brown alga	<i>Armandia bioculata</i> Hartman	polychaete worm
<i>Peyssonelia rubra</i> Weber van Bosse	red alga	ascidian unid.	compound ascidian
* <i>Phyllospadix torreyi</i> S. Watson	surf grass	<i>Astraea gibberosa</i> Dillwyn	turban snail
<i>Pilcomium coccineum</i> var. <i>pacificum</i> (Kylin) Dawson	red alga	<i>Astraea undosa</i> Wood	turban snail
<i>Prionitis cornea</i> (Okamura) Dawson	red alga	<i>Astrangia lajollaensis</i> Durham	aggregate coral
<i>Pterocladia pyramidale</i> (Gardner) Dawson	red alga	<i>Astrometis verticillifera</i> (Xantus)	sea star
<i>Pterostiphonia dendroidea</i> (Montagne) Falkenberg	red alga	<i>Astropecten verilli</i> de Loriol	sand star
<i>Pterygophora californica</i> Ruprecht	brown alga	<i>Azinella mexicana</i> de Laubenfels	sponge
Rhodophyta unid.	red algae (division)	<i>Aziothella</i> sp.	polychaete worm
<i>Rhodymenia arborescens</i> Dawson	red alga	<i>Balanophyllia elegans</i> Verrill	solitary coral
<i>Rhodymenia pacifica</i> Kylin	red alga	<i>Balanus concavus pacificus</i> Pilsbry	acorn barnacle
<i>Rhodymenia palmatiformis</i> Dawson	red alga	<i>Balanus glandula</i> Darwin	acorn barnacle
<i>Rhodymenia</i> sp.	red alga	<i>Balanus trigonus</i> Darwin	acorn barnacle
<i>Sargassum agardhianum</i> Farlow	brown alga	<i>Balcis rutila</i> Carpenter	snail
<i>Taenioma</i> sp.	red alga	<i>Barleeia</i> sp.	rissoid snail
<i>Ulva</i> sp.	green alga	<i>Bodotria</i> sp.	cumacean
		<i>Bulla gouldiana</i> Pilsbry	tektibranch
		<i>Burchia redondensis</i> Burch	tower snail
		<i>Cadlina flavomaculata</i> MacFarland	dorid nudibranch
		<i>Cadlina limbaughi</i> Lance	dorid nudibranch
		<i>Cadlina marginata</i> MacFarland	dorid nudibranch
		<i>Caecum dali</i> Bartsch	snail

* Flowering plant.

APPENDIX 2—Continued

Scientific Name	Common Name	Scientific Name	Common Name
INVERTEBRATES AND ASCIDIANS—continued			
<i>Calliostoma annulatum</i> Solander	trochid snail	<i>Diaperoecia californica</i> (d'Orbigny)	bryozoan
<i>Calliostoma gloriosum</i> Dall	trochid snail	<i>Diaulula sandiegensis</i> (Cooper)	dorid nudibranch
<i>Calliostoma supragranosum</i> Carpenter	trochid snail	<i>Didemnum carnulentum</i> Ritter and Forsyth	compound ascidian
<i>Calliostoma tricolor</i> Gabb	trochid snail	<i>Diodora murina</i> Arnold	limpet
<i>Callistochiton palmulatus</i> Carpenter	chiton	<i>Diopatra ornata</i> Moore	polychaete worm
<i>Capitella capitata</i> (Fabricius)	polychaete worm	<i>Diplodonta orbella</i> Gould	clam
Capitellidae	polychaete worm (family)	<i>Discorbis columbiensis</i> Cushman	foraminiferan
<i>Capitula ambiseta</i> Hartman	polychaete worm	<i>Dorvillea</i> sp.	polychaete worm
Caprellidae	amphipod (suborder)	Dorvilleidae	polychaete worm (family)
<i>Cellaria mandibulata</i> Hincks	bryozoan	<i>Dysidea ambia</i> de Laubenfels	sponge
Centrechinoidea	sea urchin (order)	<i>Epiactis prolifera</i> Verrill	prolific anemone
<i>Ceratosoma nuttallii</i> Conrad	snail	<i>Epialloides hilloni</i> (Rathbun)	crab
Cerianthidae	tube anemone (family)	<i>Epitonium</i> sp.	wentletrap snail
<i>Cerianthopsis</i> sp.	tube anemone	<i>Erato columbella</i> Menke	snail
<i>Certhiopsis carpenteri</i> Bartsch	snail	<i>Ervilia californica</i> Dall	clam
<i>Chaetia ovoides</i> (Gould)	pidcock	<i>Esperiopsis originalis</i> de Laubenfels	sponge
<i>Chaetopleura gemma</i> Carpenter	chiton	<i>Eteone</i> sp.	polychaete worm
<i>Chaetozona corona</i> Berkeley and Berkeley	polychaete worm	<i>Eudendrium</i> sp.	hydroid
<i>Chama pellucida</i> Sowerby	agate chama	<i>Eudistoma</i> sp.	compound ascidian
Cheilostomata	bryozoan (suborder)	<i>Eugorgia rubens</i> Verrill	gorgonian
<i>Chlamydoconcha orcutti</i> Dall	clam	<i>Eunice longicirrata</i> Webster	polychaete worm
<i>Chone</i> sp.	polychaete worm	<i>Eunice</i> sp.	polychaete worm
Chrysopetalidae	polychaete worm (family)	Eunicidae	polychaete worm (family)
<i>Chthamalus fissus</i> Darwin	acorn barnacle	eunicid unid.	polychaete worm
<i>Cirolana harfordi</i> (Lockington)	isopod	<i>Ezogone</i> sp.	polychaete worm
cirolanid unid.	isopod (family)	<i>Filicrisia</i> sp.	bryozoan
Cirratulidae	polychaete worm (family)	<i>Fissurella volcano</i> Reeve	limpet
cirratulid unid.	polychaete worm	Flabelligeridae	polychaete worm (family)
<i>Cirratulus</i> sp.	polychaete worm	flabelligerid unid.	polychaete
<i>Cirriformia</i> sp.	polychaete worm	<i>Flabellina iodinea</i> (Cooper)	aeolid nudibranch
<i>Cistenides brevicoma</i> (Johnson)	polychaete worm	<i>Folliculina</i> sp.	ciliate protozoan (attached)
<i>Conus californicus</i> Hinds	cone snail	Gammaridea	amphipod (suborder)
<i>Corynactis californica</i> Carlgren	aggregate anemone	<i>Geodia mesotriaena</i> Lendenfeld	sponge
<i>Cossura candida</i> Hartman	polychaete worm	<i>Glans carpenteri</i> Lamy	carditid clam
<i>Costazia robertsoniae</i> Canu and Bassler	bryozoan	<i>Glossodoris porterae</i> (Cockerell)	dorid nudibranch
<i>Craniella arb</i> de Laubenfels	sponge	<i>Glycera</i> sp.	polychaete worm
<i>Crepidula nummaria</i> Gould	slipper snail	<i>Golfingia</i> sp.	spunculid worm
<i>Crepidula onyz</i> Sowerby	slipper snail	<i>Goniada littorea</i> Hartman	polychaete worm
<i>Crepidipatella lingulata</i> (Gould)	half-slipper snail	<i>Gromia oviformis</i> Dujardin	testate protozoan
<i>Crisia maxima</i> Robertson	bryozoan	<i>Haliclona lunisimilis</i> de Laubenfels	sponge
<i>Crisia occidentalis</i> Trask	bryozoan	<i>Haliclona</i> sp.	sponge
<i>Crisia</i> sp.	bryozoan	<i>Haliotis fulgens</i> Philippi	green abalone
<i>Cryptosula pallasiiana</i> (Moll)	bryozoan	<i>Haliotis rufescens</i> Swainson	red abalone
<i>Cucumaria</i> sp.	sea cucumber	<i>Haploscoloplos elongatus</i> (Johnson)	polychaete worm
Cumacea	arthropod (order)	<i>Hemectyon hyle</i> de Laubenfels	sponge
<i>Cumella</i> sp.	cumacean	<i>Henricia leviscula</i> (Stimpson)	sea star
<i>Cumingia californica</i> Conrad	clam	<i>Hermisenda crassicornis</i> (Eschscholtz)	aeolid nudibranch
<i>Cyamon</i> sp.	sponge	Hesionidae	polychaete worm (family)
<i>Cyanoplax dentiensi</i> (Gould)	chiton	hesionid unid.	polychaete worm
<i>Cyanoplax</i> sp.	chiton	<i>Hiattella arctica</i> (Linnaeus)	rough nestling clam
<i>Cyllichna alba</i> Brown	snail	<i>Hinnites multirugosus</i> (Gale)	rock scallop
<i>Cystodites lobatus</i> (Ritter)	compound ascidian	<i>Hippodiplosia insculpta</i> (Hincks)	bryozoan
<i>Dendroster excentricus</i> (Eschscholtz)	sand dollar	<i>Hipponiz tumens</i> Carpenter	snail
<i>Dendrochiton</i> sp.	chiton	<i>Hopkinsia rosacea</i> MacFarland	aeolid nudibranch
<i>Dendrodonus albopunctata</i> (Cooper)	dorid nudibranch	<i>Hormomya adamsiana</i> (Dunker)	mussel
<i>Dendrodonus frondosus</i> (Ascanius)	dorid nudibranch	Hydroida	hydroid (order)
<i>Dendrostomum pyroides</i> Chamberlin	spunculid worm	<i>Hymen amphistra cyanocrypta</i> de Laubenfels	blue encrusting sponge
<i>Dermasterias imbricata</i> (Grube)	sea star	<i>Idothea rufescens</i> Fee	isopod
<i>Deziospira spirillum</i> (Linnaeus)	polychaete worm	insect larvae unid.	insect
<i>Diala acuta</i> Carpenter	litiophilid snail	<i>Ischnochiton fallax</i> Carpenter	chiton

APPENDIX 2—Continued

Scientific Name	Common Name	Scientific Name	Common Name
INVERTEBRATES AND ASCIDIANS—continued		Nematoda	nematode worm (phylum)
<i>Ischnochiton mertenii</i> (Middendorff)	chiton	Nemertina	nemertean worm (phylum)
<i>Ischnochiton radians</i> Carpenter	chiton	<i>Nephtys</i> sp.	polychaete worm
<i>Ischnochiton</i> sp.	chiton	Nereidae	polychaete worm (family)
Iso-poda	isopod (order)	<i>Nereis procera</i> Ehlers	polychaete worm
<i>Jatón festivus</i> Hinds	muricid snail	<i>Norrisia norrisi</i> Sowerby	trochid snail
<i>Kelletia kelletii</i> Forbes	whelk snail	<i>Nuttallina californica</i> (Reeve)	chiton
<i>Kellia laperousi</i> Deshayes	nestling clam	<i>Obelia</i> sp.	hydroid
<i>Lacuna unifasciata</i> Carpenter	littorinid snail	<i>Octopus bimaculatus</i> Verrill	octopus
<i>Laonice cirrata</i> (Sars)	polychaete worm	<i>Odostomia donilla</i> Dall and Bartsch	snail
<i>Leptopecten latiaurata</i> (Conrad)	kelp scallop	<i>Odostomia terricula</i> Dall and Bartsch	snail
<i>Leuconia barbata</i> (Duchassaing & Michelotti)	sponge	<i>Odostomia</i> sp.	snail
<i>Leucosolenia botryoides</i> (Ellis & Solander)	sponge	<i>Olivella baetica</i> Carpenter	olive snail
<i>Lima hemphilli</i> Hertle and Strong	file shell	<i>Olivella biplicata</i> Sowerby	olive snail
<i>Linckia columbica</i> Gray	sea star	Onuphidae	polychaete worm (family)
<i>Littia fenestrata</i> Carpenter	snail	onuphid unid.	polychaete worm
<i>Lissodendoryx noziosa</i> de Laubenfels	sponge	Opheliidae	polychaete worm (family)
<i>Listriolobus pelodes</i> Fisher	echiuroid worm	opheliid unid.	polychaete worm
<i>Lithopaga subula</i> (Reeve)	date mussel	<i>Ophiodermella incisa</i> Carpenter	snail
<i>Littorina planaxis</i> Philippi	snail	<i>Ophiodromus pugettensis</i> (Johnson)	polychaete worm
<i>Littorina scutulata</i> Gould	snail	<i>Ophiodromus</i> sp.	polychaete worm
<i>Lophogorgia chilensis</i> (Verrill)	pink gorgonian	<i>Ophionereis annulata</i> Le Conte	brittle star
<i>Lophopanepeus bellus</i> (Stimpson)	crab	<i>Ophiopores papillosa</i> (Lyman)	brittle star
<i>Lophopanepeus lockingtoni</i> Rathbun	crab	<i>Ophiothrix rudis</i> Lyman	brittle star
<i>Lotia gigantea</i> Sowerby	owl limpet	<i>Ophiothrix spiculata</i> Le Conte	brittle star
<i>Lucinoma</i> sp.	clam	Ophiuroidea	brittle star (class)
Lumbrineridae	polychaete worm (family)	Ostracoda	crustacean (subclass)
<i>Lumbrineris</i> sp.	polychaete worm	<i>Pachycerianthus</i> sp.	tube anemone
<i>Lyraula hippocrepis</i> (Hincks)	bryozoan	<i>Pachycheles</i> sp.	crab
<i>Lytechinus anamesus</i> H. L. Clark	white sea urchin	<i>Pachygrapsus crassipes</i> Randall	shore crab
<i>Macron lividus</i> Adams	snail	<i>Pagurus samuelis</i> (Stimpson)	hermit crab
<i>Magelona pacifica</i> Monro	polychaete worm	pagurid unid.	hermit crab
<i>Magelona</i> sp.	polychaete worm	<i>Pandalus gurneyi</i> Stimpson	shrimp
Maldanidae	polychaete worm	<i>Panulirus interruptus</i> (Randall)	spiny lobster
maldanid unid.	polychaete worm	<i>Paracalythys stearnsii</i> Verrill	solitary coral
<i>Marginella californica</i> Tomlin	snail	paraonid unid.	polychaete worm
<i>Marginella jewettii</i> Carpenter	snail	<i>Paraonis</i> sp.	polychaete worm
<i>Marginella</i> sp.	snail	<i>Parapholas californica</i> (Conrad)	scale-sided piddock
<i>Mediaster aequalis</i> Stimpson	sea star	<i>Parasmitina</i> sp.	bryozoan
<i>Megasturcula remondii</i> Gabb	tower snail	<i>Parastichopus californicus</i> (Stimpson)	sea cucumber
<i>Megasthura crenulata</i> Sowerby	keyhole limpet	<i>Parastichopus parvimensis</i> (Clark)	sea cucumber
<i>Membranipora tuberculata</i> (Bose)	bryozoan	<i>Patiria miniata</i> (Brandt)	bat star
<i>Micranellum crebricinctum</i> Carpenter	snail	<i>Pectinaria californiensis</i> Hartman	polychaete worm
<i>Microciona parthena</i> de Laubenfels	sponge	<i>Pelia clausa</i> Rathbun	crab
microcionid unid.	sponge	<i>Pelia tumida</i> (Lockington)	crab
<i>Micrura nigrirostris</i> Coe	nemertean worm	<i>Penitella penita</i> (Conrad)	flap-tipped piddock
<i>Micrura pardalis</i> Coe	nemertean worm	<i>Pentamera</i> sp.	sea cucumber
<i>Miniacina miniacea</i> (Pallas)	colonial foraminiferan	<i>Petalaster joliotata</i> (Grube)	sand star
<i>Mitra catalinae</i> Dall	miter snail	<i>Petrolisthes cinctipes</i> (Randall)	crab
<i>Mitra idae</i> Melville	miter snail	<i>Petrolisthes</i> sp.	crab
<i>Mitrella carinata</i> Hinds	keeled snail	<i>Pherusa inflata</i> (Treadwell)	polychaete worm
<i>Mitrella gouldii</i> Carpenter	snail	<i>Phidiana pugnax</i> Lance	aeolid nudibranch
<i>Mitrella tuberosa</i> Carpenter	snail	<i>Phidolopora pacifica</i> (Robertson)	lacy bryozoan
<i>Mitrella</i> sp.	snail	<i>Philobrya setosa</i> Carpenter	clam
<i>Modiolus capax</i> Conrad	fat horse-mussel	Phoronida	phoronid worm (phylum)
<i>Mopalia citata</i> (Sowerby)	chiton	<i>Phragmatopoma californica</i> (Fewkes)	polychaete worm
<i>Mopalia muscosa</i> (Gould)	chiton	<i>Phyllochaetopterus prolifica</i> Potts	polychaete worm
<i>Muricea californica</i> Verrill	gorgonian	Phyllocodidae	polychaete worm (family)
Mysidacea	crustacean (order)	phyllocodid unid.	polychaete worm
<i>Mytilus californianus</i> Conrad	mussel	pilargid unid.	polychaete worm
<i>Mytilus edulis</i> Linnaeus	bay mussel		
<i>Nassarius mendicus</i> Gould	whelk snail		
<i>Nassarius</i> sp.	whelk snail		

APPENDIX 2—Continued

Scientific Name	Common Name	Scientific Name	Common Name
INVERTEBRATES			
AND ASCIDIANS—continued			
<i>Pilargis hamatus</i> Hartman.....	polychaete worm	<i>Spiophanes bombyx</i> (Claparède).....	polychaete worm
<i>Pisaster giganteus</i> (Stimpson).....	sea star	<i>Spiophanes missionensis</i> Hartman.....	polychaete worm
<i>Platylhelminthes</i>	flatworm (phylum)	<i>Stelletta estrella</i> de Laubenfels.....	sponge
<i>Plocamia karykina</i> de Laubenfels.....	sponge	<i>Stenoplax conspicuus</i> (Pilsbry).....	chiton
<i>Plumularia lagenifera</i> Allman.....	hydroid	<i>Sternopsis fassor</i> Stimpson.....	polychaete worm
<i>Plumularia setacea</i> (Ellis).....	hydroid	<i>Strongylocentrotus franciscanus</i> (Agassiz).....	red sea urchin
<i>Plumularia</i> sp.....	hydroid	<i>Strongylocentrotus purpuratus</i> (Stimpson).....	purple sea urchin
<i>Pododesmus cepio</i> (Gray).....	abalone jingle	<i>Strongylocentrotus</i> sp.....	sea urchin
<i>Pocillochaetus johnsoni</i> Hartman.....	polychaete worm	<i>Styela montereyensis</i> (Dall).....	solitary ascidian
<i>Pollicipes polymerus</i> Sowerby.....	stalked barnacle	<i>Stylatula elongata</i> (Gabb).....	sea pen
<i>Polychaeta</i> unid.....	segmented worms (class)	<i>Stylatula</i> sp.....	sea pen
<i>Polycinum planum</i> (Ritter and Forsyth).....	compound ascidian	<i>Sycon</i> sp.....	sponge
<i>Polydora</i> sp.....	polychaete worm	<i>Syllidae</i>	polychaete worm (family)
<i>Polynoidae</i>	polychaete worm (family)	<i>Syllis</i> sp.....	polychaete worm
<i>Porifera</i> , dark brown unid.....	sponge	<i>Tanadacea</i>	tanaiid crustacean (order)
<i>Porifera</i> , encrusting unid.....	sponge	<i>Tealia coriacea</i> (Cuvier).....	sea anemone
<i>Porifera</i> , encrusting yellow unid.....	sponge	<i>Tedania topsenti</i> de Laubenfels.....	sponge
<i>Porifera</i> , orange unid.....	sponge	<i>Tegula aureotincta</i> Forbes.....	trochid snail
<i>Prazillella affinis pacifica</i> Berkeley.....	polychaete worm	<i>Tegula funebris</i> (Adams).....	trochid snail
<i>Prazillella</i> sp.....	polychaete worm	<i>Tegula ligulata</i> Menke.....	trochid snail
<i>Prianos problematicus</i> de Laubenfels.....	sponge	<i>Tegula regina</i> Stearns.....	trochid snail
<i>Prionospio pinnata</i> Ehlers.....	polychaete worm	<i>Tegula</i> sp.....	trochid snail
<i>Prionospio pygmaeus</i> Hartman.....	polychaete worm	<i>Tellina</i> sp.....	clam
<i>Prionospio</i> sp.....	polychaete worm	<i>Terebellidae</i>	polychaete worm (family)
<i>Protothaca staminea</i> Conrad.....	clam	<i>Terebellides stroemi</i> Sars.....	polychaete worm
<i>Psolid holothurian</i> unid.....	sea cucumber	<i>Terebratalia transversa</i> (Sowerby).....	brachiopod
<i>Pterynotus trialatus</i> (Sowerby).....	murex snail	<i>Terebratulina unguicula</i> Carpenter.....	brachiopod
<i>Pugettia dalli</i> Rathbun.....	crab	<i>Tethya aurantia</i> (Pallas).....	orange sponge
<i>Pugettia producta</i> (Randall).....	crab	<i>Tetracita squamosa rubescens</i> Darwin.....	acorn barnacle
<i>Pugettia</i> sp.....	crab	<i>Tharyx parvus</i> Berkeley.....	polychaete worm
<i>Pycnogonida</i>	arthropod (class)	<i>Tharyx</i> sp.....	polychaete worm
<i>Pycnopus helianthoides</i> (Brandt).....	sea star	<i>Thyonopsis nutrens</i> Clark.....	sea cucumber
<i>Pyura hauster</i> (Stimpson).....	solitary ascidian	<i>Travisia brevis</i> Moore.....	polychaete worm
<i>Retusa harpa</i> Dall.....	snail	<i>Tricolia compta</i> Gould.....	snail
<i>Rhynchozoon tumulosum</i> (Hineke).....	bryozoan	<i>Trididemnum opacum</i> (Ritter).....	compound ascidian
<i>Sabellaria cementarium</i> Moore.....	polychaete worm	<i>Triaktrion flabelliformis</i> Hentschel.....	leaf sponge
<i>Sabellaria gracilis</i> Hartman.....	polychaete worm	<i>Triopha maculata</i> MacFarland.....	dorid nudibranch
<i>Sabellariidae</i>	polychaete worm (family)	<i>Tritonia festiva</i> (Stearns).....	nudibranch
<i>Sabellidae</i>	polychaete worm (family)	<i>Trypanosyllis</i> sp.....	polychaete worm
<i>sabellid</i> unid.....	polychaete worm	<i>Tubulipora</i> sp.....	bryozoan
<i>Salmacina tribranchiata</i> (Moore).....	polychaete worm	<i>Tubuliporidae</i>	bryozoan (family)
<i>Scalpellum californicum</i> Pilsbry.....	stalked barnacle	<i>Turbonilla chocolata</i> Carpenter.....	turbonille snail
<i>Scrupocellaria diegensis</i> Robertson.....	bryozoan	<i>Turbonilla kelseyi</i> Dall and Bartsch.....	turbonille snail
<i>Scrupocellaria</i> sp.....	bryozoan	<i>Volvulella cylindrica</i> Carpenter.....	snail
<i>Seila montereyensis</i> Bartsch.....	snail	<i>zoantharian</i> , white unid.....	cnidarian (subclass)
<i>Serpula vermicularis</i> Linnaeus.....	polychaete worm	<i>Zonaria spadicea</i> (Swainson).....	chestnut cowry
<i>Serpulidae</i>	polychaete worm (family)		
<i>Serpulorbis squamigerus</i> (Carpenter).....	tube-building snail	VERTEBRATES	
<i>Sertularella pedrensis</i> Torrey.....	hydroid	<i>Agonopsis stierletus</i> Gilbert.....	sea poacher
<i>Sertularella turgida</i> (Trask).....	hydroid	<i>Arctedius corallinus</i> (Hubbs).....	coralline sculpin
<i>Stigillaria aequali-siphonis</i> (Ritter and Forsyth).....	social ascidian	<i>Arctedius lateralis</i> (Girard).....	smoothhead sculpin
<i>Sipunculida</i>	sipunculid worm (phylum)	<i>Arctedius</i> sp.....	true sculpin
<i>Solariella varicosa</i> Mighels and Adams.....	snail	<i>Atherinops affinis</i> (Ayres).....	topsmelt
<i>Solaster dawsoni</i> Verrill.....	sea star	<i>Branchiostoma californiense</i> Andrews.....	California lancelet
<i>Sphaerodorium</i> sp.....	polychaete worm	<i>Caulolatilus princeps</i> (Jenyns).....	ocean whitefish
<i>Sphaerosyllis</i> sp.....	polychaete worm	<i>Chromis punctipinnis</i> (Cooper).....	blacksmith
<i>Spionidae</i>	polychaete worm (family)	<i>Citharichthys stigmaeus</i> Jordan and Gilbert.....	sanddab
<i>spionid</i> unid.....	polychaete worm	<i>Clinocottus analis</i> (Girard).....	wooly sculpin
		<i>Coryphopterus nicholsi</i> (Bean).....	bluespot goby
		<i>Cottidae</i>	cottid (family)
		<i>Cryptotrema corallinum</i> (Gilbert).....	coralline clind
		<i>Embiotoca jacksoni</i> Agassiz.....	black perch
		<i>Girella nigricans</i> (Ayres).....	opaleye

APPENDIX 2—Continued

Scientific Name	Common Name	Scientific Name	Common Name
VERTEBRATES—continued			
<i>Gobiesox rhesodon</i> Rosa Smith.....	clingfish	<i>Rhacochilus toxotes</i> Agassiz.....	rubberlip perch
<i>Gymnothorax mordax</i> (Ayres).....	moray eel	<i>Rhacochilus vacca</i> (Girard).....	pile perch
<i>Hypsurus caryi</i> (Agassiz).....	rainbow seaperch	<i>Scorpaena guttata</i> Girard.....	sculpin
<i>Medialuna californiensis</i> (Steindachner)	halfmoon	<i>Scorpaenichthys marmoratus</i> (Ayres).....	cabezon
<i>Myliobatis californicus</i> Gill.....	bat ray	<i>Sebastes atrovirens</i> (Jordan and Gilbert)	kelp rockfish
<i>Neoclinus stephensae</i> Hubbs.....	yellowfin fringehead	<i>Sebastes dalli</i> (Eigenmann and Beeson)	calico rockfish
<i>Neoclinus uninotatus</i> Hubbs.....	onespot fringehead	<i>Sebastes miniatus</i> (Jordan and Gilbert)	vermillion rockfish
<i>Oxyjulis californica</i> (Günther).....	señorita	<i>Sebastes serranoides</i> Eigenmann and Eigenmann	olive rockfish
<i>Oryzias pictus</i> Gill.....	painted greenling	<i>Sebastes serripes</i> (Jordan and Gilbert)	treefish
<i>Paralabraz clathratus</i> (Girard).....	kelp bass	<i>Sebastes vexillaris</i> (Jordan and Gilbert)	whitebelly rockfish
<i>Paralabraz nebulifer</i> (Girard).....	sand bass		
<i>Pimelometopon pulchrum</i> (Ayres).....	sheephead		
<i>Rathbunella hypoplecta</i> (Gilbert).....	smooth ronquil		
<i>Rathbunella</i> sp.....	ronquil		

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